JOURNAL

OF THE

American Veterinary Medical Association

FORMERLY AMERICAN VETERINARY REVIEW

(Original Official Organ U. S. Vet. Med. Ass'n.)

H. Preston Hoskins, Secretary-Editor, 716 Book Building, Detroit, Mich.

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MEMBERSHIP

In the preceding issue of the Journal, an editorial discussed the subject of A. V. M. A. finances. It was pointed out that the Association has reached a point where it becomes necessary to provide additional income if the activities of the national body are to be increased and expanded. One way of securing the needed additional income was suggested, namely, by increasing the annual dues. This is a perfectly logical way out of the present difficulty, but it is not by any means the only way out. Of course, a larger membership would provide a larger income. A larger membership too, is highly desirable, but at the same time the fact should not be lost sight of that certain expenses would be increased incident to a larger number of members. Putting this fact another way, it may be said that the additional income from dues that would be derived from a certain number of new members would not be entirely available for additional activities.

In the report of the Secretary-Editor for the past year, also published in the October issue of the Journal, it was shown that the A. V. M. A. running expenses now average very close to $2.00 per member. An additional thousand members could be handled without materially increasing our overhead expenses. Nevertheless, no small part of the $2.00 which the Association would receive as dues from these new members would be consumed in continuing the activities in which the organization already is

engaged, on a larger scale, commensurate with the larger membership. In other words ours is not a business where all income in excess of a certain amount is "velvet."

This question has already been asked by several: Is it not likely that a considerable number of members of the A. V. M. A. will drop out if the annual dues are increased to $8.00? This question can not be answered definitely, but, as such things go, we could expect to lose a few members who would feel that they could not afford to continue as members at $8.00 per year. Getting right down to brass tacks, the Association actually would be ahead, with a smaller number of members paying the increased dues suggested. But that is not the right way to look at the proposition. The Association should have as its aim the desire to be of service to every veterinarian in the country. As a matter of fact, and as pointed out on previous occasions, the Association frequently does things which benefit every veterinarian, whether he is a member of the Association or not. Furthermore, right along we are performing services for veterinarians who do not support the Association. We have never once refused to render a service to a veterinarian just because he was not a member. This will continue to be our policy.

Even though the A. V. M. A. now has enrolled a larger number of members than at any time in the past, it is a fact that our membership represents only approximately 50 per cent of the graduate veterinarians in the United States and Canada. Surveys made during the present year enable us to know just where these non-members are located. It is not difficult to find these 4,500 non-members when we know that in one state alone there are approximately 500 and almost as many more in an adjoining state. States with a hundred or more non-members are not hard to find. Just why these states should lag behind is difficult to understand. Membership campaigns have been conducted in these states with comparatively little success. To sum up the situation that exists in these states, in a single word, we can find no better one than "indifference." Meanwhile several of the smaller states show practically a 100 per cent A. V. M. A. membership. What a splendid thing it would be if every present member of the A. V. M. A. would make up his mind to secure at least one new member during the coming year. Some members (not resident secretaries, either) secured as many as a dozen new members during the year which recently closed.

Membership in the A. V. M. A. now costs less than one-third of a cent per day. It is proposed to increase it to a little more than one cent per day.

INTEREST IN POULTRY DISEASES INCREASES

This is the fifth issue of the JOURNAL in which all papers deal with questions related to poultry diseases.* The increased interest which veterinarians are taking in poultry practice is very encouraging, and the number is increasing right along. One of the most gratifying features of the recent Detroit convention was the way the members attended the session of the newly organized Section on Poultry, which met for the first time this year. If there were any who had misgivings concerning the outcome of the experiment, these were dispelled completely. The address of Chairman Stafseth is published in this issue.

Another indication of the fact that the A. V. M. A. is awake to the responsibilities imposed on the profession, by reason of the vast capital invested in poultry, is the creation of the Committee on Poultry Diseases, which functioned for the first time the past year. The report made by the Committee at the Detroit meeting was published in the JOURNAL last month.

At the present time there are three poultry diseases that are of major importance: tuberculosis, bacillary white diarrhea and fowl-pox. All present real problems in prophylaxis and control and a great deal of work is being done in studying these problems, some of which is presented in the papers published in this issue. The possibility of another serious problem is apparent in the report on Bang disease in the fowl, by Emmel and Huddleson.

The transmission of fowl-pox by mosquitoes—a comparatively recent discovery—is discussed by Beaudette, and the very latest observations on vaccination against the disease are reported by Beach, of California, and Johnson, of Oregon, working independently. Bunyea and his associates in the U. S. Bureau of Animal Industry upset our ideas relative to certain postmortem findings that have been associated with pullorum disease for a long time. Edwards and Hull, of the Kentucky Station, report further on the agglutination test as employed in pullorum disease studies. Bushnell, Payne and Coon, of the Kansas Station, continue their studies on the forced-draft type of incubator as a spreader of pullorum disease infection, giving the results of their

*The previous poultry disease numbers were published in May, 1925; February, 1926; February, 1927; and February, 1928.

experiments in fumigating these necessary adjuncts of the poultry farm. State Veterinarian Hays, of Nebraska, goes into the subject of controlling avian tuberculosis, with his characteristic enthusiasm and thoroughness.

VETERINARY STUDENT ENROLLMENT FOR 1929-1930

Information supplied by the deans of the various veterinary colleges in the United States and Canada reveals another healthy increase in the enrollment of veterinary students this year. The increase shown is a trifle less than that shown last year over the year 1927-1928. One year ago, practically every college showed an increase over the previous year, but three of the colleges this year report a small decrease in enrollment, with no change either way at the Ontario Veterinary College. Nine colleges show an increase this year, the number running as high as thirty-nine in the case of Iowa State College. For the first time in quite a while, the total enrollment exceeds the thousand mark. The low point in recent years was reached during the college year 1924-1925, when the number of veterinary students fell to 604. The enrollment this year would indicate an increase of almost 80 per cent during the past five years.

The University of Montreal appears in the list again this year. No figures were available at the time our report was made one year ago. With the opening of the 1928-1929 session, the School of Veterinary Medicine of the University of Montreal that had been located in Montreal for a number of years was transferred to Oka, La Trappe, Quebec, and completely re-organized. At a meeting held at Oka on September 18, 1929, the name of the school was changed to the School of Veterinary Medicine of Quebec.

One of the most important indications of the trend in veterinary education is the decision of the Iowa State College to limit the enrollment of veterinary students. We are informed by Dean Stange that sixty freshman students is about the capacity of the present classrooms and laboratories at the Iowa institution. In the interests of the veterinary students, it is felt that it is better to limit the classes and in this way give the maximum benefit possible to the students. It is believed that this is in the interests of the future of the profession and, by limiting the number of freshman students admitted, it will be possible to practice some selection and admit only those young men who give the greatest

promise of developing into the type of men which the veterinary profession needs. There can be only one result from a policy of this kind and that is the elevation of the standards of the veterinary profession to a still higher plane. After all, the profession can not be any better than the men who constitute it.

Another encouraging indication is found in the fact that more than a score of graduate veterinarians are now pursuing post-graduate work in four of our veterinary colleges. Some of these men are working toward a Master's degree, whereas several have already secured this degree and are now working toward the degree of Doctor of Philosophy. The time will come when a man with only his veterinary degree will find it rather difficult to secure a good position, whereas the man who has taken post-graduate work will have a decided advantage in this respect.

The number of freshman students enrolled this year shows an increase of only about 6 per cent over one year ago. The sophomores show quite an increase (71) over last year, this being the result of the large increase in the freshman enrollment one year ago. There is a slight increase (38) in the number of junior students. The seniors show an increase (32) and we can look forward with reasonable assurance to seeing approximately 175 men graduated in 1930, as against 138 this year. In the accompanying table special students are those who are not definitely assignable, at this time, to any of the four classes. Graduate students reported in the table include only those who have the veterinary degree and are working for an advanced degree. For

Veterinary student enrollment for the college year 1929-1930

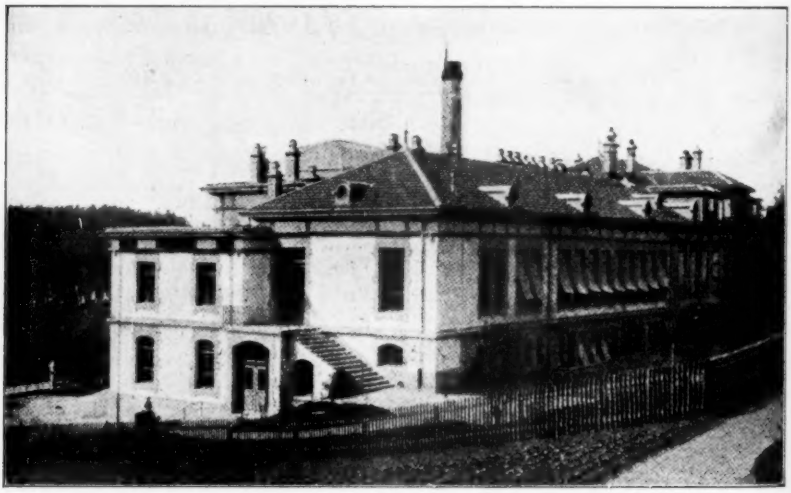
	Fr.	Soph.	Jun.	Sen.	Spec.	Grad.	Total	1928–29	Change
Alabama P. I.	9	10	2	10	3	0	34	26	+ 8
Colorado A. C.	37	26	23	12	0	0	98	72	+26
Cornell Univ.	32	40	33	23	1	6	135	138	— 3
Georgia S. C.	13	17	9	2	0	0	41	34	+ 7
Iowa State Col.	60	55	38	29	2	3	187	148	+39
Kansas S. A. C.	56	26	15	17	4	0	118	83	+35
Michigan S. C.	8	10	7	9	0	8	42	35	+ 7
Montreal, Univ. of.	8	2	0	2	0	0	12	15	— 3
Ohio State U.	35	28	33	24	0	4	124	108	+16
Ontario V. C.	21	25	19	16	0	0	81	81	0
Penna. Univ. of.	42	26	21	18	0	0	107	88	+19
Texas A. & M. C.	7	9	3	1	0	0	20	18	+ 2
Washington, S. C. of	20	24	20	21	0	0	85	86	— 1
Totals	348	298	223	184	10	21	1084	932	+152

the purpose of getting a correct index of the veterinary student situation, the figures for graduate students could quite properly be left out of consideration.

INTERNATIONAL VETERINARY CONGRESS

In the July issue of the JOURNAL (page 115), it was announced that membership in the International Veterinary Congress would cost $5.00. Dr. Adolph Eichhorn recently received word from Prof. J. Basil Buxton, honorary secretary of the 11th International Veterinary Congress, to the effect that the membership dues have been raised from $5.00 to $7.50 (30 shillings). Dr. Eichhorn has a supply of blank applications for membership and will be pleased to send one to any veterinarian in the United States who desires to become a member of the Congress and receive a copy of the published proceedings.

Members of the profession in Canada, desiring to join the International Veterinary Congress, even though they may not be able to attend, should apply to Dr. George Hilton, Ottawa. Dr. Hilton is the Canadian member of the Permanent Committee of the Congress and will be pleased to supply application forms to prospective members. Remember that the subscription fee is 30 shillings ($7.50).



Main Building, Serum Institute, Berne, Switzerland.

APPLICATIONS FOR MEMBERSHIP

(See July, 1929, JOURNAL)

FIRST LISTING

BLACKMAN, RAYMOND A. Box 212, Vienna, Va.
D. V. S., U. S. College of Veterinary Surgeons, 1913
Vouchers: R. E. Brookbank and H. C. Givens.

FARLEY, HERMAN
Dept. of Vet. Path., Kansas State Agr. College, Manhattan, Kansas
D. V. M., Kansas State Agricultural College, 1926
Vouchers: Joseph P. Scott and J. H. Burt.

GONZAGA, ARCADIO C. College of Vet. Science, Agr. College, Laguna, P. I.
D. V. M., University of the Philippines, 1926
Vouchers: Gregorio San Agustin and Angel K. Gomez.

GREFSHEIM, THORVAL Deerfield, Wis.
D. V. M., Chicago Veterinary College, 1916
Vouchers: James S. Healy and H. D. Larzelere.

HAYS, MACK Box 2246, Ala. Poly. Institute, Auburn, Ala.
D. V. M., Iowa State College, 1927
Vouchers: M. L. Boevers and C. A. Cary.

JUNGERMAN, GEORGE F. Hiawatha, Kans.
D. V. S., Kansas City Veterinary College, 1908
Vouchers: A. T. Kinsley, J. D. Ray and F. L. Hart.

MCCOY, JAMES OWEN Reeseville, Wis.
B. V. Sc. V. S., Ontario Veterinary College, 1925
Vouchers: James S. Healy and H. D. Larzelere.

MACKEY, GRAHAM L. Bedford, Va.
D. V. M., Chicago Veterinary College, 1915
Vouchers: W. B. Holmes and Leroy E. Bowen.

MEYER, E. ALBERT 2958 Elizabeth St., Denver, Colo.
D. V. S., Colorado Agricultural College, 1910
Vouchers: W. C. Dye and T. A. Shipley.

MOTT, LAWRENCE ORVILLE
Vet. Hospital, Kansas State Agr. College, Manhattan, Kansas
D. V. M., Kansas State Agricultural College, 1929
Vouchers: Edwin J. Frick and Edward R. Frank.

SCHWARTE, L. H. Vet. Investigation, Iowa State College, Ames, Iowa
D. V. M., Iowa State College, 1928
Vouchers: H. H. Dukes and C. H. Stange.

SWINGLEY, LEE B. 700 Jackson St., Oregon, Ill.
M. D. C., Chicago Veterinary College, 1909
Vouchers: I. N. Habecker and E. F. Legner.

WILLIAMSON, C. O. Powell, Wyo.
D. V. M., Ohio State University, 1920
Vouchers: Cecil Elder and John T. Dallas.

ZIMMERMAN, ISRAEL 16 Poplar Terrace, Bridgeport, Conn.
V. M. D., Grand Rapids Veterinary College, 1906
Vouchers: Chas. C. E. Atkins and Thomas B. Burriss.

Applications Pending

SECOND LISTING

Benson, Samuel Ocile, Box 384, Raleigh, N. C.
Bouton, Jr., Jay H., 9357 E. Colfax Ave., Aurora, Colo.
De Camp, Daniel, 403 W. Broadway, Sedalia, Mo.
Lee, Capt. Frank M., Army Veterinary School, Army Medical Center, Washington, D. C.

McCapes, Adelbert Morten, Ore. Agr. College, Experiment Sta., Corvallis, Ore.
Newlin, Theodore A., Dixie National Stock Yards, Memphis, Tenn.
Sharp, Fred Harvey, Box 80, Stockyards Sta., Denver, Colo.
Smalley, James Luther, Dublin, Ga.
Vinson, Fletcher LeRoy, 426 W. North Ave., Baltimore, Md.

The amount which should accompany an application this month is $5.83, which covers membership fee and dues to January 1, 1930, including subscription to the JOURNAL. It is suggested that applications filed this month be accompanied by remittance for $10.83, the additional $5.00 being for the 1930 dues.

COMING VETERINARY MEETINGS

Connecticut Veterinary Medical Association. Waterbury, Conn. November 6, 1929. Dr. E. H. Patchen, Secretary, 83 New Haven Ave., Milford, Conn.

New York City, Veterinary Medical Association of. Academy of Medicine, 5th Ave. and 103rd St., New York, N. Y. November 6, 1929. Dr. Raymond J. Garbutt, Secretary, 305 W. 91st St., New York, N. Y.

San Diego-Imperial Veterinary Medical Association. San Diego, Calif. November 6, 1929. Dr. I. P. Immenschuh, Secretary, Santee, Calif.

Chicago Veterinary Society. Great Northern Hotel, Chicago, Ill. November 12, 1929. Dr. J. B. Jaffray, Secretary, 2956 Washington Blvd., Chicago, Ill.

Kansas City Association of Veterinarians. New Baltimore Hotel, Kansas City, Mo. November 12, 1929. Dr. J. D. Ray, Secretary, 400 New Centre Bldg., Kansas City, Mo.

Purdue University, Veterinary Short Course. Purdue University, Lafayette, Ind. November 12-14, 1929. Dr. R. A. Craig, Department of Veterinary Science, Purdue University, Lafayette, Ind.

Hudson Valley Veterinary Medical Society. Poughkeepsie, N. Y. November 13, 1929. Dr. J. G. Wills, Secretary, 122 State St., Albany, N. Y.

Southeastern Michigan Veterinary Medical Association. Detroit, Mich. November 13, 1929. Dr. H. Preston Hoskins, Secretary, 716 Book Bldg., Detroit, Mich.

Southern California Veterinary Medical Association. Chamber of Commerce Bldg., Los Angeles, Calif. November 20, 1929. Dr. W. L. Curtis, Secretary, 1264 W. 2nd St., Los Angeles, Calif.

Keystone Veterinary Medical Association. Philadelphia, Pa. November 27, 1929. Dr. C. S. Rockwell, Secretary, 5225 Spruce St., Philadelphia, Pa.

Illinois State Veterinary Medical Association. La Salle Hotel, Chicago, Ill. December 2-3, 1929. Dr. W. H. Welch, Secretary, Lexington, Ill.

Horse Association of America. Palmer House, Chicago, Ill. December 4, 1929. Mr. Wayne Dinsmore, Secretary, Union Stock Yards, Chicago, Ill.

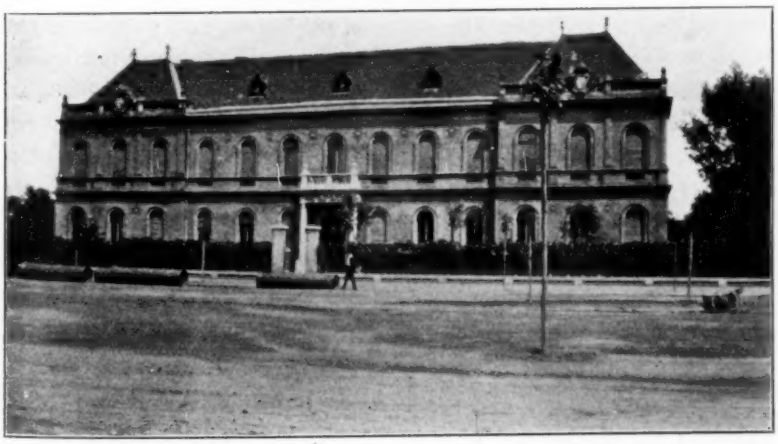
United States Live Stock Sanitary Association. La Salle Hotel, Chicago, Ill. December 4-6, 1929. Dr. O. E. Dyson, Secretary, 45 Live Stock Exchange Bldg., Wichita, Kans.

Nebraska State Veterinary Medical Association. Grand Island, Nebr. December 10-11, 1929. Dr. B. Witt, Secretary, Scribner, Nebr.

American Association for the Advancement of Science. Des Moines, Iowa. December 27, 1929-January 2, 1930. Dr. Burton E. Livingston, Permanent Secretary, Smithsonian Institution Bldg., Washington, D. C.

Kansas Veterinary Medical Association and Kansas State Agricultural College Conference for Veterinarians. Kansas State Agricultural College, Manhattan, Kans. January 7-8, 1930. Dr. Chas. W. Bower, Secretary, 1128 Kansas Ave., Topeka, Kans.

Ohio State Veterinary Medical Association. Deshler-Wallick Hotel, Columbus, Ohio. January 8-9, 1930. Dr. R. E. Rebrassier, Secretary, Ohio State University, Columbus, Ohio.



Bacteriological Institute, Veterinary College, Budapest.

THE VETERINARIAN'S OBLIGATION TO THE POULTRY INDUSTRY*

By H. J. STAFSETH

Department of Bacteriology, Michigan State College
East Lansing, Michigan

If it were not for the fact that this is the first time that the American Veterinary Medical Association has had a Section on Poultry, I should not attempt to make a chairman's address. As it is, a few remarks may be in order. What I say may be ancient history, but *factum est* that certain things in ancient history bear reviewing.

In order to emphasize rather than show, which is so often done, the need of adequate veterinary service in the field of poultry diseases, I wish to call your attention, first, to the importance of the poultry industry; second, to the importance of the disease problem to the poultryman; and, third, to the immediate need for adjustment of veterinary education and practice to the requirements of modern poultry husbandry.

THE IMPORTANCE OF THE POULTRY INDUSTRY

Unfortunately I have no figures more recent than those of the United States Department of Agriculture report of 1923. However, there is no reason for believing that any statistical comparisons, dealing with the industries to be mentioned and applicable to 1929, would be less impressive than those of 1923.

The total value of the poultry crop was $1,040,000,000.00 annually, which is greater than the value of all the cattle in the United States, six times the value of all horses and mules, seven times the value of sheep, and twelve times the value of all wool. It exceeded the value of the wheat crop by $300,000,000.00, was worth half that of the corn crop, was considerably greater than that of all other cereals combined, five times the value of the apple crop, seven times the value of all sugar crops, three times that of the tobacco crop, four times the value of the commercial truck and garden crops, twice the combined value of potato and sweet potato crops, three times that of forest products, and twice the value of all fruits combined. No further comment on the importance of the poultry industry is necessary.

*Address of chairman of Section on Poultry. Presented at the sixty-sixth annual meeting of the American Veterinary Medical Association, Detroit, Mich., August 13-16, 1929.

The Importance of the Disease Problem to the Poultryman

The following estimated annual disease losses apply to the state of Michigan.

Twenty per cent of all commercial hatchery chicks sold, die with bacillary white diarrhea, representing a loss of 3,000,000 chicks. At thirteen cents per chick this amounts to $390,000.00. Approximately six per cent of all hens in the State are affected with avian tuberculosis, causing an annual loss of about $960,000.00 at an estimated value per hen of $1.00. Coccidiosis, typhoid, cholera, blackhead and worms cause annual losses of at least $1,000,000.00. During the past year it is quite certain that one million hens were lost as a result of fowl-pox, which, at the price of $1.00 per hen, amounts to about $3,350,000.00 and to this should be added the losses due to decreased production. Thus the limiting factor of the poultry industry is the loss caused by disease. No wonder that intelligent and up-to-date poultrymen are desirous of obtaining efficient veterinary service.

Veterinary Education and Practice as Applied to Poultry

At the present, most poultrymen go to the county agricultural agents and extension poultry husbandrymen for advice as to their disease problems. Yes, even veterinarians in the field not infrequently address their inquiries and submit their autopsy material to the professors and instructors of poultry husbandry of the various state colleges and universities, rather than to members of the veterinary staff of the institution concerned. The reasons for this, I think, are well known, but I shall mention them again. They are: first, veterinarians in general were too slow in adjusting themselves to the needs of this industry, which again was due at least partly to the fact that our veterinary schools were negligent in regard to instruction in matters appertaining to poultry; and, second, veterinarians and laymen almost alike have been too slow in realizing that the principles of health and disease in poultry are little or no different from those of other live stock, and that the well-trained veterinarian, therefore, by virtue of his knowledge of the sciences fundamental to any branch of medicine, should be able to adjust himself and his services to the poultry disease problem.

What is the Remedy?

I do not pretend to be able to prescribe the exact therapeutic dose of the magic cure, but it is obvious that the veterinary

colleges must give more time to instruction in poultry hygiene, nutrition and pathology. Veterinarians, especially those practicing in poultry centers, ought to be as willing and desirous to take special post-graduate courses in poultry pathology as are many agricultural graduates, and here I do not refer merely to the conventional, more or less ineffective, short courses now offered throughout the country. Furthermore, the veterinary profession must find an effective way to reach the poultryman with a type of service that he can use with profit to himself and adequate remuneration to the veterinarian.

Since veterinary practice, as applied to a horse, dog, or cow, must of necessity be somewhat different from that affecting poultry, as regards to fees, a new problem has presented itself and it may or may not be easily solved. A veterinary practice act will not solve it. The feeling on the part of the poultryman that a veterinarian's service is better than that of a layman, when it comes to disease problems, is quite surely the remedy *par excellence*. This feeling he must acquire through personal experience, and we must furnish that experience.

After all the only justification for the existence of our profession or of any profession, should be that men trained along a certain line can render better service than those who are not so trained. A full realization of this should make us conscientious in our efforts, jealous of the reputation of our profession and hence better public servants. The Section on Poultry of this Association should be the medium through which those of us, who are interested in poultry-disease problems, should strive to bring into existence better veterinary education and more effective service with regard to poultry hygiene, pathology and therapeutics. This Section is in its infancy, and you know infant mortality is often high. If the Section on Poultry is to live, the poultry practitioners, pathologists and teachers must be loyal to it.

Fowl Pest in New Jersey

About the middle of June, Dr. F. R. Beaudette, poultry pathologist of the New Jersey Agricultural Experiment Station, reported an outbreak of European fowl pest in New Jersey. His diagnosis was confirmed by Dr. Hubert Bunyea, of the U. S. Bureau of Animal Industry, and immediate steps were taken by state and government officials to eradicate the disease. Close observations at the surrounding market centers since have failed to show any evidence of the disease. The manner of its introduction is still undetermined.

AVIAN TUBERCULOSIS IN NEBRASKA*

By C. H. HAYS, *Lincoln, Nebr.*

Chief, Nebraska Bureau Animal Industry

In presenting a discussion, with limits suggested by the title for this paper—"Avian Tuberculosis in Nebraska"—before a meeting with such possible variations of interest as may be here represented, it is obvious that such discussion should have a broader scope than the title indicates. It would serve no especially useful purpose to limit the discussion to that of reviewing available evidence as to the prevailing incidence and morbidity rate of avian tuberculosis within the comparatively small area of a single state, as of Nebraska. However, if by a review of work completed in Nebraska, in making positive determination of the prevalence of tuberculosis among the poultry in defined areas, the possibilities of certain sanitary measures as a practical way in which to combat the infection of avian tuberculosis may be shown, and their value emphasized, then the discussion will have been justified as a part of the program of this Association.

A certain background of information is desirable in order that a mutual understanding may obtain as to the position Nebraska occupies in agriculture, particularly as relates to poultry production. Through its geographic location and the development of natural land resources, the State is in an important position agriculturally as one of the group of states which lie, in part or whole, within the broad expanse of the upper Mississippi River Basin, commonly referred to as the Corn Belt. The states in the group include North Dakota, South Dakota, Nebraska, Kansas, Missouri, Iowa, Minnesota, Wisconsin, Illinois, Indiana, Michigan and Ohio. Though agriculture within the area of these several states is subject to many diversities peculiar to sectional differences in land and climate, and the effect of colonization, there are many agricultural enterprises within said area presenting similarities in methods and practices of common usage. Poultry-raising, as practiced on the farms of these states, presents many such common uniformities in production, with resultant problems of quite the same cause and effect.

Within the area of the twelve states, poultry production has grown to a position of considerable economic importance, and

*Presented at the sixty-sixth annual meeting of the American Veterinary Medical Association, Detroit, Mich., August 13-16, 1929.

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A certain background of information is desirable in order that a mutual understanding may obtain as to the position Nebraska occupies in agriculture, particularly as relates to poultry production. Through its geographic location and the development of natural land resources, the State is in an important position agriculturally as one of the group of states which lie, in part or whole, within the broad expanse of the upper Mississippi River Basin, commonly referred to as the Corn Belt. The states in the group include North Dakota, South Dakota, Nebraska, Kansas, Missouri, Iowa, Minnesota, Wisconsin, Illinois, Indiana, Michigan and Ohio. Though agriculture within the area of these several states is subject to many diversities peculiar to sectional differences in land and climate, and the effect of colonization, there are many agricultural enterprises within said area presenting similarities in methods and practices of common usage. Poultry-raising, as practiced on the farms of these states, presents many such common uniformities in production, with resultant problems of quite the same cause and effect.

Within the area of the twelve states, poultry production has grown to a position of considerable economic importance, and

*Presented at the sixty-sixth annual meeting of the American Veterinary Medical Association, Detroit, Mich., August 13-16, 1929.

colleges must give more time to instruction in poultry hygiene, nutrition and pathology. Veterinarians, especially those practicing in poultry centers, ought to be as willing and desirous to take special post-graduate courses in poultry pathology as are many agricultural graduates, and here I do not refer merely to the conventional, more or less ineffective, short courses now offered throughout the country. Furthermore, the veterinary profession must find an effective way to reach the poultryman with a type of service that he can use with profit to himself and adequate remuneration to the veterinarian.

Since veterinary practice, as applied to a horse, dog, or cow, must of necessity be somewhat different from that affecting poultry, as regards to fees, a new problem has presented itself and it may or may not be easily solved. A veterinary practice act will not solve it. The feeling on the part of the poultryman that a veterinarian's service is better than that of a layman, when it comes to disease problems, is quite surely the remedy *par excellence*. This feeling he must acquire through personal experience, and we must furnish that experience.

After all the only justification for the existence of our profession or of any profession, should be that men trained along a certain line can render better service than those who are not so trained. A full realization of this should make us conscientious in our efforts, jealous of the reputation of our profession and hence better public servants. The Section on Poultry of this Association should be the medium through which those of us, who are interested in poultry-disease problems, should strive to bring into existence better veterinary education and more effective service with regard to poultry hygiene, pathology and therapeutics. This Section is in its infancy, and you know infant mortality is often high. If the Section on Poultry is to live, the poultry practitioners, pathologists and teachers must be loyal to it.

Fowl Pest in New Jersey

About the middle of June, Dr. F. R. Beaudette, poultry pathologist of the New Jersey Agricultural Experiment Station, reported an outbreak of European fowl pest in New Jersey. His diagnosis was confirmed by Dr. Hubert Bunyea, of the U. S. Bureau of Animal Industry, and immediate steps were taken by state and government officials to eradicate the disease. Close observations at the surrounding market centers since have failed to show any evidence of the disease. The manner of its introduction is still undetermined.

AVIAN TUBERCULOSIS IN NEBRASKA*

By C. H. HAYS, *Lincoln, Nebr.*

Chief, Nebraska Bureau Animal Industry

In presenting a discussion, with limits suggested by the title for this paper—"Avian Tuberculosis in Nebraska"—before a meeting with such possible variations of interest as may be here represented, it is obvious that such discussion should have a broader scope than the title indicates. It would serve no especially useful purpose to limit the discussion to that of reviewing available evidence as to the prevailing incidence and morbidity rate of avian tuberculosis within the comparatively small area of a single state, as of Nebraska. However, if by a review of work completed in Nebraska, in making positive determination of the prevalence of tuberculosis among the poultry in defined areas, the possibilities of certain sanitary measures as a practical way in which to combat the infection of avian tuberculosis may be shown, and their value emphasized, then the discussion will have been justified as a part of the program of this Association.

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Within the area of the twelve states, poultry production has grown to a position of considerable economic importance, and

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matters affecting the welfare of said industry become of more or less national concern. Estimates, obtained from statistical records in the joint cooperative office of the United States Department of Agriculture and the Nebraska Department of Agriculture at Lincoln, show that, as of January 1, 1925, the total chicken population on farms in the United States totaled a little more than 425,000,000 birds. Of such poultry population, fifty-two per cent were on farms within the area of the twelve states named, and 6.4 per cent, or one-eighth of the 52 per cent, were on Nebraska farms. From the same source of information, it was ascertained that 12,104 cars of live poultry were on the New York markets during 1927; of which 68 per cent were from the same twelve states, and during 1928 sixty per cent of 11,227 cars. Nebraska delivered 12.4 per cent of the sixty-eight per cent, and 15.8 per cent of the sixty per cent. There were 400,000,000 pounds of dressed poultry on the New York, Philadelphia, Chicago and Boston markets during 1927, of which 75 per cent came from the same twelve states, and 348,000,000 pounds in 1928, with 74 per cent from these states. Of such percentages Nebraska contributed 5.1 per cent in 1927, and 6.8 per cent in 1928. The Boston, New York, Philadelphia, Chicago, San Francisco and Los Angeles markets combined received a total of slightly over 16,500,000 cases of eggs in 1927 and a similar amount in 1928, of which 65 per cent in 1927 and 63 per cent in 1928 came from these mid-western states. Nebraska contributed, of these percentages, 5.5 per cent in 1927, and 6.9 per cent in 1928.

Production Methods Improved

The great volumes of poultry and poultry produce marketed from the farms of these states, returning as they have much cash wealth, have been largely from an unregulated growth of practices in animal husbandry rather than any particular cultivation of the practices. During recent years, as a fuller appreciation of the economic values in poultry has been realized, a more serious interest has been given to improvement of production methods. This has been rather more noticeable in changes which offered promise of increased production, and has been more popular among operators engaged in breeding enterprises than in general production. One almost universally adopted change has been the replacement, by mechanical devices, of the hen in hatching and subsequent brooding operations. Though an increasing amount of the poultry products of this area are now coming from special-

ized operations, the great mass of production is yet retained by the average farm flock, maintained in most instances incident to other farm activities rather than as a primary project of farm management. The flock has free range, the absence of such practice tending to make the poultry operation conspicuous. Whatever the improvements have been, until very recently none have been effected with special attention to poultry hygiene for prevention of disease.

Under the general conditions and the practices, as have been operative within the various parts of the area, the infections of diseases to which poultry are susceptible have had an exceedingly fertile field for spread and development. This has been evidenced time and again through the display by serious losses caused from such diseases as fowl cholera, fowl typhoid, pullorum disease, coccidiosis and other parasitic invasions. Though tuberculosis as a disease among poultry has appeared in a less demonstrable manner, it has nevertheless made rapid progress, and has spread within a comparatively short time to the flocks within the area until it occupies at present a very prominent place among the diseases with which the poultry industry must now reckon. One observer clearly explains the situation by stating:

> While a relatively small number of persons, either engaged in live stock sanitation or in the investigation of animal diseases, were vaguely aware of the rapidly growing incidence of avian tuberculosis, it is fair to state that the extent and morbidity rate of this disease has only been revealed during very recent years.

Flock Morbidity In Tuberculosis

At the 1928 annual meeting of the United States Live Stock Sanitary Association there was distributed by the federal Bureau of Animal Industry a compilation of data relating to the progress and status of tuberculosis eradication work, dated December 1, 1928. While the materials contained relate particularly to bovine tuberculosis, one table, numbered 16, presents a record of surveys of tuberculosis among poultry made by veterinarians engaged in the tuberculin-testing of cattle under the area plan. The table was a summary of findings, the result of physical examination of poultry flocks in approximately twenty-eight states, covering a period from 1925 to 1928. A total of 671,528 flocks came under observation, of which 42,219 (6.3 per cent of the total examined) were reported to have contained tuberculous birds, thereby infected. The states in which these surveys were made were not recorded in the published report, but a map prepared in graphic form was issued by the same bureau, on July 1, 1928, which in-

dicated the probable extent of tuberculosis among poultry in the different areas of the United States. Within the area, including in part or whole the twelve states to which special reference hereinbefore has been made, except Kansas, the flock morbidity rate was estimated at seven per cent or more. That such estimate was not excessive, but rather understated the situation, is indicated by supplemental surveys, including specific testing and research studies, which have been made.

Extent of Disease in Three Midwestern States

Reports were made at the third annual Midwestern States Tuberculosis Conference, in St. Joseph, Missouri, in May, 1927, which recorded the positive findings of tuberculosis among poultry as the result of tuberculin tests applied in area form on flocks in certain of the midwestern states. Dr. W. F. Crewe, state veterinarian of North Dakota, reported having officially tested 62 flocks of chickens within the area of a single township in North Dakota. Of 4,017 birds tested, 240 were classified to be reactors; and these reactors came from 48 different flocks, or 77+ per cent of the total number of flocks tested. Mr. W. A. Peck, commissioner of live stock at the South St. Paul Live Stock Exchange, reporting for Minnesota, recorded the testing of poultry flocks in two modified accredited counties. In one of the counties 132 flocks, containing 28,000 birds, were tested, of which flocks 66 per cent were found to contain infected birds and 22 per cent of the birds tested were classified to be reactors. In the other county 65 flocks, containing 9000 birds, were tested, showing 75 per cent of the flocks infected and 11.6 per cent of the birds reactors. In a paper before the same conference, Dr. J. O. Wilson, inspector in charge of field activities of the United States Bureau of Animal Industry in South Dakota, reported the testing of poultry flocks of a defined area in a South Dakota county during October, 1926. The tests included 72 flocks, containing 9,116 birds, of which flocks sixty-six (93 per cent) contained tuberculous fowls. The average incidence of the infection among the birds was 12.8 per cent, but in birds over one year of age the incidence averaged 34.4 per cent while in the birds under one-year old, five-tenths of one per cent. A similar report was made relating to Nebraska which has been incorporated as a part of a summary hereinafter presented.

Another type of investigation, but definitely reflecting the prevalence of avian tuberculosis, has been carried out at two

agricultural experiment stations in the area of these same mid-western states, namely at the Illinois Experiment Station and at the Nebraska Experiment Station. Dr. Robert Graham reported, before the 29th annual meeting of the United States Live Stock Sanitary Association, on a study of the relation of avian to porcine tuberculosis. This study was relative to the presence of the infection of avian tuberculosis among swine slaughtered and examined under federal meat inspection service at the Chicago and St. Louis markets. These studies were similar to an inquiry made by Doctors Van Es and Martin, in Nebraska, into the cause of the increase of tuberculosis of swine. Such Nebraska work concerned the typing of tuberculosis from lesions found in swine slaughtered under federal inspection, principally at the Missouri River markets, and particularly of swine from Nebraska and Iowa farms. The lesions were principally those of the isolated cervical type responsible for the large mass of the retentions made on account of tuberculosis in swine. At the Illinois Station, 81 per cent of the cases studied were determined to be of avian origin, and at the Nebraska Station, 88.5 per cent. At the Nebraska Station, 209 different cases were studied.

Testing Started in Nebraska

Prompted by the findings in the field investigations in Nebraska, by veterinarians engaged in examining poultry flocks for tuberculosis, and by the studies at the Nebraska Experiment Station previously referred to, the Nebraska Department of Agriculture, assisted by the United States Bureau of Animal Industry, became engaged during 1927 in tuberculin-testing the poultry flocks in defined areas of three different counties of Nebraska. One county was in the northeastern, another in the central and the other in the southeastern part of the State. In each of these counties all herds of cattle had been tested under the area plan, and as a result each county had been and was at the time certified to be a modified accredited area. More than 70 per cent of the flocks in the areas of operation were submitted to test. A detailed report of the work was published in the proceedings of the 31st annual meeting of the United States Live Stock Sanitary Association,* and also included in the biennial report, for 1927-1928, of the Nebraska Department of Agriculture, therefore will be omitted from this paper. However, reference to the general summary of the Nebraska work is desirable.

*Hays, C. H.: A report of tuberculin-testing of poultry flocks in Nebraska. Jour. A. V. M. A., lxxii (1928), n. s. 25 (6), pp. 880-889.

A total of 291 different flocks, containing exclusively chickens totaling 40,073 birds, were tested. These were located within the area of four townships, one each in two counties and two in the other county. A classification of the birds tested was made into two groups according to age. In the one group were included birds more than one year old, and in the other, birds one year old or less, based in the spring testing of 1927 as to whether the birds were hatched in 1926 or whether they were hatched earlier, the earlier hatching being considered over one year old. In the fall testing of 1927 the grouping was as to whether hatched in the spring of 1927 or earlier, the earlier hatch again being included as older than one year. These classifications were, it must be acknowledged, but relatively correct except possibly of the testing in October, 1927. Under such classification, 57.7 per cent of the chickens tested were listed as one year or less, and 42.2 per cent as over one year of age.

Results of the Test

As a result of the tests applied 3,760 chickens were classified to be reactors, representing 9.3 per cent of the total birds tested. Classified as to age, 843 reactor birds (3.6 per cent of all reactors) were one year old or less and 2,917 birds (17 per cent) were over one year old. This becomes particularly significant in evaluating the sanitary measures hereinafter suggested. Where it was not possible to determine the age so accurately, the difference in the incidence of disease between the groups was not so great as where age could be more accurately determined, as in Johnson County, where tests were applied in October, 1927. The reactors in that county among young birds represented 1.1 per cent of a total of 1,696 reactors, as against 19.5 per cent among the older birds. The flock morbidity rate of all areas combined averaged 74.3 per cent, the highest being 92.3 per cent in one township and the lowest 50.6 per cent in another. Put in other words, on the average three out of each four flocks tested were found to be infected with tuberculosis.

Evidence of such an extensive prevalence of tuberculosis among poultry in the same areas from which bovine tuberculosis has been so definitely eradicated, as in the districts in which the testing reported was completed, makes pertinent the question of the relation of tuberculosis among poultry to the presence of tuberculosis among cattle. It has been positively determined that the bacillus of the avian type may account for tuberculous lesions in

cattle. The practical issue, however, is as to what extent tuberculous poultry on the farm may be responsible for tuberculosis in cattle revealed by the tuberculin test. Table I presents data re-

TABLE I—*Comparative tuberculin-testing of chickens and cattle in defined areas in Nebraska showing percentage incidence of reactor animals, and flock and herd morbidity rates established by tests*

Area (Township)	Poultry			Cattle		
	Year Tested	Reactor Incidence (%)	Flock Morbidity (%)	Year Tested	Reactor Incidence (%)	Herd Morbidity (%)
1	1927	8.3	92.7	1924 1925 1929	0.56 0.38 0.0	4.4 3.8 0.0
2	1927	16.0	78.3	1924 1925 1929	1.54 0.29 0.4	13.9 4.2 3.8
3	1927	4.1	50.6	1926 1927	1.09 0.73	10.0 6.7
4	1927	9.6	76.6	1925 1929	1.1 0.42	4.0 6.3

lating to such question. It has been prepared from records of tuberculin tests of both chickens and cattle in the territory of these defined areas which are under primary consideration at this time as to the testing of poultry flocks. The table shows the percentage incidence of tuberculosis of chickens and of cattle, and the flocks and herd morbidity rates. The tests of cattle prior to 1929 were preliminary to certification of the different counties, of which the townships were a part, as modified accredited areas. The tests of 1929 were for reaccreditation purposes. The two counties in which testing was applied in 1929 were recertified as such accredited areas.

It will be noted that in each of the defined areas represented there was a low incidence and morbidity rate of tuberculosis among cattle, in contrast to a particularly high morbidity rate and a comparatively high incidence among poultry. Particular attention is directed to township 1, with a morbidity rate of 92 per cent among the poultry flocks after the initial accrediting test, in which not a case of tuberculosis was revealed among the cattle at the time of the reaccrediting tests in 1929, and in an area where all herds and flocks were strictly farming activities.

It would appear from these limited observations that under field conditions tuberculosis among poultry is not a potent factor in accounting for the source of tuberculosis occurring among cattle. It is appreciated that the observations are limited and not conclusive but may enter into the answer of the question advanced as vital in the ultimate eradication of animal tuberculosis.

Chickens that were classified reactors in the testing completed were destroyed by slaughter, and submitted to a postmortem inspection arranged for the purpose by the Nebraska Department of Agriculture. Cooperative assistance was had from the meat inspection service of the United States Bureau of Animal Industry station at Omaha and from a certain poultry produce house, which engaged in purchasing and slaughtering of the reactor birds. As previously recorded, there were 3,760 reactor chickens, and of these 245 were either killed on the premises where the tests were applied, because of being unfit physically for market purposes, or were unaccounted for in the postmortem records because of having been destroyed in transit to market. The total of reactors slaughtered under inspection was 3,515. Classified as to whether the carcasses of the birds were fit for food purposes, the records disclose that 2,786 (79.3 per cent) were passed for food and 729 (20.7 per cent) were condemned as not fit for food purposes. Positive lesions of tuberculosis were demonstrated in the bodies of all reactor birds except 181, which gives a rating of no-visible-lesion cases of 5.1 per cent. The most common seat for the lesions of tuberculosis in the affected birds slaughtered was in the liver, the spleen, the intestines, and the lungs in the order named. There were very few bone-deforming lesions noted in the carcasses of the affected birds. Another conspicuous thing was the high percentage of carcasses condemned on account of extensive or generalized tuberculosis of birds in good to excellent flesh, and of which a physical examination would undoubtedly have failed as a means for indicating the disease.

Tuberculin Found Reliable In Poultry

The tests completed further demonstrate tuberculin, intradermally used, to be an accurate and practical means for determining the presence of the infection of tuberculosis in chickens, equal to the accepted efficacy of tuberculin on cattle. The average cost of the tests applied on the chickens in these areas approximated 10 cents per bird. This cost would have been considerably reduced had the expense been restricted to testing operations only. As

recorded, the expense includes in addition to testing services, the service of organization for testing, and assistance in marketing of reactors and in making postmortem examinations of the same. Tuberculin-testing of poultry, with a reasonable volume of birds and the cooperation of the flock-owners in handling the fowls, would not entail a prohibitive expense, and the same would be sound economically if individual animal and production values are combined as a basis for such economic determination.

In the matter of the prevention, control or eradication of an infectious and contagious disease among live stock, it is obvious that a definite knowledge as to the presence and location of the given infection is highly essential. However, there are several factors to be considered in the practical dealing with a disease situation as is presented by tuberculosis among poultry in Nebraska, and in the other parts of the area of which Nebraska is reasonably representative, as indicated by recorded facts. It does not appear, under *existing* conditions, particularly desirable or feasible to engage in a program for the eradication of tuberculosis from poultry such as has applied in the instance of cattle. It would be uneconomical, if not prohibitive, in view of such facts, to engage in the systematic testing of all flocks. As progress obtains, a limited use of tuberculin may properly be made in determing the presence of the infection of avian tuberculosis, or even at present in flocks of extra values in birds, but tuberculin will not serve in the basic way it has in the suppression of bovine infection.

Give the Old Hens a Ride

The Nebraska Department, after a thorough review of the evidence and facts in hand, and guided with the able counsel from certain associations, has reached the conclusion that the first attack on tuberculosis among poultry in the State must be to reduce the mass of infection coming from that source. The most effective and practical way, it has been decided, will be to "Give the Old Hens a Ride," and why? This is a rather popular play with a phrase, but conveys the literal meaning of the way suggested as the most practical plan to secure the effect desired. A pamphlet was prepared and distributed by the Nebraska Department of Agriculture, through various channels to reach the poultry producer, from which three short paragraphs are taken, which very concisely and clearly explain the measures of sanitation suggested for attacking tuberculosis among poultry. The

pamphlet was edited under the caption above quoted, "Give the Old Hens a Ride." The paragraphs read as follows:

> Avian tuberculosis is transmitted through the infected droppings by which food and drinking water is polluted. It is therefore subject to sanitary control measures. Fowls in the latter stages of tuberculosis scatter enormous numbers of germs on the premises.
>
> The principal, if not the only spreaders of poultry tuberculosis are the older fowls. Tuberculosis is but rarely seen in fowls less than six months old. Affected fowls less than one year old are not apt to have developed the disease to such an extent as to become spreaders of infection.
>
> The most effective measure of protection against poultry tuberculosis is the elimination of older fowls. Hens should be gotten rid of prior to becoming two years old, and in infected flocks the age limit should be not over one year.

The plan suggested is simple and in primary application should not be difficult. The average flock-owner should be convinced of the practical and economical value, especially the latter, when the relation of age to egg-production in chickens is considered, in view of facts established by reliable experimental evidence. The Nebraska Agricultural Experiment Station, and several other similar experiment stations, have shown that there is an approximate reduction of from twenty-five to thirty per cent in such egg-production the second year over that of the first year. For the average farm flock, in which products and not breeding represent the basic value, a one-year-turnover method would be recommended, in which instance the entire flock would be disposed of to market at the end of the first laying period. In the breeding flock the time could be continued, under proper restrictions, to the end of the second period.

Infected Premises Must Be Made Safe

More will be involved than strictly flock rotation in order to secure the highest possible efficiency from the practice in the reduction of tuberculosis. With the marketing of old birds the great mass of infection will be eliminated, but the contamination retained on premises having been occupied by old birds may remain a fertile field for infection of young birds. The plan should therefore include such other sanitary efforts necessary to make premises safe for poultry, to wit: rotation of poultry-yards, clean water and unpolluted food. It is not essential to discuss these, as merely naming them will be sufficient to indicate their importance in the issue.

The task of securing the adoption of such sanitary measures will prove very difficult in view of the fact that their adoption involves a change in habits and customs of the human being. The practices of poultry husbandry which must become changed

have come largely from following what others have done or are doing. The plan offered deviates in a decidedly radical way from the general arrangements pursued in raising poultry in the Middle West, especially in that area with which this discussion is more particularly concerned. What has been good enough in the past will be the hallowed ghost which will stalk the earnest efforts made by those who would correct the condition which has become established so insidiously. The task will not be impossible but the realization will not come merely by spreading information and advice through printed matter, or from the work of a single departmental service regardless of its efficiency. Object lessons will be needed and education of a most definite form, with eventual penalty through restrictive measures on the diseased animals. The veterinarian, in private as well as in public service, may serve in a most useful way, and particularly the private practitioner who can do so much in an advisory way in the confidence he shares with the many flock-owners, in having a fuller and more definite understanding of the situation brought to the attention of the producer. It is another subject to discuss in full the task and its solution. The problem is no greater or more intricate than others which are being attacked with such great success. It is a matter of getting together and at it.

In conclusion, the possibility of error in certain estimates, which have been made and applied beyond the limits of Nebraska, must be acknowledged. Much of the evidence which has been used has been of the fragmentary sort, but in so far as known is reliable to the fullest degree, and errors made have been by reason of personal deductions. Tuberculosis as a disease of poultry is not to be credited as an acute and immediate menace in all intensive poultry-raising areas, for it has been found only to a limited extent in some of the larger poultry-producing areas along the eastern seaboard and in California. However, these conditions have not been the result of happenstance but have been incidental to the application of methods and practices fundamentally similar to the plan that has been suggested in this paper for combating the infection of avian tuberculosis.

Such plan was not adopted in poultry raising in these different areas as a measure of poultry hygiene to prevent tuberculosis, but has nevertheless operated in preventing tuberculosis among poultry. The intensive production methods, as practiced in California and elsewhere, may not be adaptable to Nebraska conditions, but the fundamental principles which have apparently

so successfully protected against tuberculosis will be applicable under the conditions prevailing in the areas where tuberculosis is at present taking such a heavy toll. A challenge is presented to the live stock sanitary department of each of the several states of the group to which reference has been especially made, and it is believed that the greatest success may be had if these several states can be brought into action under a plan that will present the same concerted force as has been applied in the instance of combating tuberculosis among cattle.

Discussion

Dr. E. A. Watson: We are interested in some work on avian tuberculosis. We realize the importance of it in connection with general attempts to eliminate tuberculosis from live stock, but we are studying avian strains more particularly in connection with various other types of tubercle bacilli, which may or may not be the avian type.

I think there are possibly a number of types of tubercle bacilli for which there are no ways and means of classifying them, such as the avian, or some other type.

We frequently say, "We have a type of bacillus which tends toward the avian type, or toward the bovine type," meaning we are trying to classify those strains. In the susceptibility of rabbits and poultry, one strain will lead more toward the avian type, that is to say, it will infect poultry and possibly rabbits if not guinea pigs, and other strains will infect guinea pigs and poultry and, possibly, rabbits as well, but we have been struck with the possible significance of changes in the virulence of these strains by passage through one or more of these species.

At the first isolation of a stra n from a bovine source, which, as I say, leads toward the avian type, we have succeeded in infecting poultry, guinea pigs, or rabbits, possibly, in the first passage; but, on passing it through the fowl, we have found it pathogenic for rabbits, in some cases, and in other cases not for rabbits but for guinea pigs.

I am not going further into that point; it is merely to illustrate that these types vary, apparently, very considerably, and we are in a somewhat difficult state, at present, when we speak of the avian type, as exclusively of the avian type, and disregard the fact that this may be an intermediary type. It means a very difficult problem.

It is a line of research that has to be taken up, I think, and a very important line of research, and it has a bearing, possibly, on the paper that I just heard in the other section, on the fate of acid-fast bacilli introduced into the peritoneal cavity of guinea pigs, and what may be the effect on the guinea pig by the avian strain or the one from a bovine source. It doesn't do to draw conclusions as to the pathogenesis of that particular animal until we have passed it through the whole series, possibly not once but two or three times.

Dr. A. D. Goldhaft: Recently there has been an order issued from the New York Department of Health that chickens that are used for canning purposes cannot be brought into the city of New York and be sold unless they are inspected at the various canning-houses. They have found a lot of tuberculosis in chickens that are brought from Kansas, Iowa, Nebraska and the other western states.

I bring that point out just on account of the work that we are doing now in Vineland, New Jersey, with the egg-producing bird. It has not been mentioned by Dr. Hays, and I thought I would bring that to his attention.

We have had a lot of trouble with our egg-producing birds. By the way, among the more progressive breeders we keep our birds over four and five years, and sometimes seven years. We have among those birds, sometimes, various

infectious diseases, and we have been practicing, for the last four or five years, permanent confinement in our birds. We have not only eliminated parasitic infestations but, to a very large extent, the extension of duodenal and other infections.

I think, if it is possible, Doctor Hays might study, in that large state of his, the question of permanent confinement of the baby chick. If they raise them on that plan I don't think it will be necessary to continue to test the birds, because, I understand those birds are marketed before they are a year old.

DR. W. T. SPENCER: The idea presented by the last speaker has been given a lot of consideration in Nebraska. Dr. Hays did not refer much to that, but the Extension Service of the Nebraska College of Agriculture has, for the past three or four years in particular, been giving considerable attention to that thought of permanent confinement for raising and producing poultry, and it is an advanced idea and one that each state can well give some attention to, not only from the standpoint of the control of disease in poultry but from the standpoint, especially, of the control of tuberculosis in hogs. That is more of a problem in the states referred to by Dr. Hays than it is in New Jersey, perhaps, and some of the eastern and New England states, where the hog production is not such a vital part of farming.

But, in these farming states, the permanent confinement, that is, the handling of the flocks under a system such as New Jersey has been following, would be of very great benefit, not only from the standpoint of poultry production but from the standpoint of controlling tuberculosis in hogs, which is a very costly and extensive disease in the hog-producing states.

I am very glad that Dr. Goldhaft brought that point out here and I hope that the other states may stress this idea more and more, of permanent confinement of the poultry flock.

This question raised by Dr. Watson, also, is one that we should consider seriously, because it has not been very many years since we, as sanitary officers, were believing and preaching the fact that tuberculosis in cattle was very largely confined to tuberculosis in cattle and the bovine type of tuberculosis was responsible for practically all of the hog tuberculosis.

But we have found out that that is not true, and the probabilities are that the ideas expressed here by Dr. Watson will prove, as we go along, that tuberculosis on the farm can adjust itself, in time, to a universal interchanging between all of the various kinds of live stock that are produced on the farm—poultry, hogs and cattle.

DR. HAYS: In dealing with this subject I fully appreciate that more could have been said explanatory to the discussion. I doubt whether it would be practical at this time to preach the strict confinement of poultry under the conditions that I have set forth and which prevail in the area that I am representing as a sanitary officer. Probably we could have reduced to fewer words the point we are driving at, and that is that a reduction in the great mass of infection with which we are apparently confronted will involve practices of animal husbandry as much as any other remedial measure.

The discussion, as I presented it, should leave the thought that there is a bigger future, a bigger work with which we must become engaged. I have not attempted to deal with the subject in a technical way, but have tried to present it in a readable order with an endeavor to present the thought that it may have a further development.

DR. A. B. CURTISS: Dr. Hays stated that about ninety-five per cent of the reactors were used for food. How extensive were the lesions in those that were used for food?

DR. HAYS: As you are informed, no doubt, the primary lesions of tuberculosis in poultry occur in organs which are not subject to primary foci of infection in other meat-producing animals. Lesions that are primary in poultry would be systemic in other classes of animals, as in cattle and swine, and would be cause for condemnation of carcasses under meat-inspection regulations of such other animals. Where we found a slight lesion in the spleen, in inspecting poultry, the carcass was passed for food provided it was in good shape otherwise. If we found a slight lesion in the liver, we would pass the carcass for food if it was good otherwise. We passed for food carcasses of birds where the lesions in the liver were more extensive than in the instance of lesions in the

spleen, which is to say that we considered liver foci of tuberculosis as more primary than the spleen foci. In no instance would we pass for food carcasses of birds in which there were numerous foci in either the liver or the spleen, and in no instance would we pass a carcass for food where we found foci in both the liver and spleen in the same bird.

We had to attack this problem on our own assumption of what should be passed and what should not. These matters could not be determined from the regulations of federal meat inspection. The conditions prevailing in the animals we were dealing with were primary.

One thing that impressed us greatly was the number of lesions that are found in the lungs, a location where we did not expect to find lesions so commonly as was experienced in the process of our examinations.

DR. CURTISS: Were the lesions acute?

DR. HAYS: No, I would not call them acute, as far as the macroscopic examination would determine.

DR. WATSON: I was interested in the last statement of the last speaker. I was interested to note that in a great many cases it is usually inspected, because, what interests me, is that two strains that we have recently isolated, when crossed, produce in chickens remarkably active lung lesions. It is unique.

DR. H. C. H. KERNKAMP: In a statistical way, I have collected data on the distribution of the lesions in birds, where I have examined the entire carcass.

I agree with the statement that the liver lesions occur in most cases; spleen, second, and intestines third.

On the 500 birds examined in this way, the liver lesions occurred in 87 per cent of the cases; the spleen lesions in 72 per cent, the intestinal in 60, and then we drop down to the lungs, 2 per cent, and heart, bone and skin lesions, down to one, and even less than one per cent of the cases.

The nodules in the lungs of chickens are not always tuberculous since we have found many of them to be old lesions of pullorum disease. We have isolated pullorum from these tuberculous-looking lung lesions.

DR. HAYS: There is one factor, the effect of tuberculosis as a disease of poultry upon the producer in the income that is to be derived, which has not been approached. We anticipate that this will be forcibly impressed upon our area when it is confronted with the work that is being instituted and that will result ultimately in the postmortem examination of poultry at the time of slaughter. That there will be a wholesale or very widespread reaction must be expected, and I am quite sure that when that reaction comes that there will be a great interest in efforts to combat avian tuberculosis.

There are many things that could be mentioned that would be of interest to this subject, but I did not want to become too personal and reflect too seriously on anybody.

Indiana Regulates Against Bang Disease

The Indiana Live Stock Sanitary Board has promulgated a regulation making it unlawful for anyone to dispose of cattle, except for immediate slaughter, which have reacted to the agglutination test for Bang disease, unless the seller of the cattle shall have made known to the prospective buyer that the cattle are infected with said disease.

Another regulation, which went into effect October 1, 1929, requires that all cattle over five months of age, brought into Indiana, shall be accompanied by a certificate, issued by an accredited veterinarian, showing that the cattle have passed a negative agglutination test for Bang disease within a period of thirty days prior to shipment.

SOME ASPECTS OF FOWL-POX AND ITS CONTROL*

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A disease commonly referred to as chicken-pox, but also known as contagious epithelioma (epithelioma contagiosum), avian molluscum, avian or fowl diphtheria, or simply diphtheria, canker, infectious coryza (coryza infectiosa), roup, fowl- or bird-pox, is known to everyone. Obviously, all of these designations are not equally fitting. In fact, some of them connote an entirely erroneous impression of the nature of the disease, and for this reason one name should be selected with the idea of its being both appropriate and sufficiently inclusive. With these points in mind, Goodpasture[1] selected the term fowl-pox as being sufficiently descriptive and inclusive.

ETIOLOGY

The idea that various protozoa and bacteria associated with pox and thought to have been concerned in its etiology had to be abandoned in 1902, when Marx and Sticker[2] demonstrated that the causative agent would pass a Berkefeld filter. The etiological relationship existing between a form of diphtheria and the cutaneous disease was studied by Carnwath, in 1908, who was able to reproduce the latter with infectious material coming from cases of the former. In 1910, Uhlenhuth and Manteufel[3] produced comb lesions on a bird with material taken from the throat of another and, by using material from the throat of a bird in a second outbreak, they were able to produce pox on the comb of one bird and diphtheria in the throat of another. The birds in a third outbreak investigated by them showed both diphtheria and pox lesions, and with material from the cutaneous lesions they were able to produce diphtheria, and with diphtheritic material they were able to produce pox lesions. Although the findings of Carnwath and of Uhlenhuth and Manteufel have been confirmed by others, there still remains the question of the existence of a form of diphtheria not associated with a filtrable virus. In 1884, Loeffler described a bacillus which he took to be the cause of diphtheria. V. Krajewski[4] was able to produce diphtheria in fowls and pigeons by inoculating

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them with material from fresh diphtheritic lesions, but he could not decide whether the organism seen by him was the same as that described by Loeffler. Babes and Puscariu[5] also concluded that pigeon diphtheria was associated with the bacillus of Loeffler, and Loir and Ducloux[6] found a similar organism in the cases examined by them. Using the medium employed in the cultivation of the whooping-cough bacillus, Bordet and Fally[7] obtained the growth of a very small organism from cases of diphtheria in fowls, and, in 1912, Bordet[8] reported the isolation of the same organism from similar cases in pigeons. These investigators contend, however, that this form of diphtheria is not associated with contagious epithelioma. Harrison and Streit[9] reported that they could produce diphtheria with *B. pyocyaneus* or their *B. cacosmus*.

It is not surprising that a variety of organisms may be isolated from cases of diphtheria, and that lesions resembling diphtheria may be produced by inoculating cultures into the mucosa. There is also the possibility that the filtrable virus was associated with the cultures used in inoculation experiments. None of these investigators tested the immunity of their birds to the filtrable virus following recovery from the disease induced by cultures. The fact that such a variety of organisms was incriminated is significant, and since the work of earlier investigators has not been confirmed, there is reason to doubt the part played by the various organisms described by them as the cause of diphtheria.

Species Affected

The disease is exceedingly common in chickens, less common in pigeons and turkeys. Uhlenhuth and Manteufel found the disease in partridge. Dean and Marshall[10] reported an outbreak in the wood pigeon and Gallagher[11] met with the disease in quail. An interesting infection of the chipping sparrow was studied by Musselmann[12] and found to be caused by fowl-pox. Statements to the effect that ducks and geese are sometimes affected with pox are not uncommon in the literature, but the fact remains that Doyle and Minett[13] were unable to infect ducks artificially. te Hennepe[14] did not observe a case of pox in 304 ducks examined by him during 1925-26, yet this disease in chickens is very common in Holland.

Epizoological Consideration

It is generally recognized that birds of all ages, unless previously exposed, are equally susceptible to fowl-pox, although

the disease is usually not seen in very young birds or in those over a year old. We have observed a serious outbreak of fowl-pox in battery-brooded chicks, and occasionally a flock will escape an attack during the first year, only to be affected during the second. Under natural conditions, however, the disease makes its appearance in young birds just about the time they are placed in the laying quarters. Soon after this, the disease reaches epizootic proportions. According to Johnson,[15] the disease is present in the Pacific Northwest to some extent throughout the year, but is most serious during the fall and winter. In Holland, judging from the number of birds received by te Hennepe for examination, the incidence increases gradually from September on, reaches a high point by the first of the year, and then declines gradually, there being only a few cases from March to September. According to v. Heelsbergen,[15] a similar seasonal variation obtains for Belgium and other parts of Northern Europe. In the Middle Atlantic states, pox regularly makes its appearance in the fall and rages until the first of the year. A few outbreaks occur in the spring.

There appears to be some difference in the type of lesions shown at different times of the year. During the fall and early winter, the cutaneous lesions predominate in most outbreaks, while, during the winter months, the diphtheritic form is usually most common. Brumley and Snook[17] observe that the cutaneous form predominates in warm weather and in warm climates, while the mucous membrane form is more common in cold weather or in northern climates.

Insofar as the inoculated disease is concerned, all breeds of fowls are equally susceptible. Under natural conditions, however, there seems to be some difference in susceptibility. Cary[18] was the first to call attention to the fact that breeds with large combs seem to be more susceptible than those with small combs. More recently, Johnson has stated that heavy breeds such as Barred Plymouth Rocks do not appear to become affected as commonly as Leghorns. The disease does not appear to be so common in the Middle West, where heavy breeds are kept, as on either coast, where commercial poultry farming is carried on with Leghorns.

Doyle and Minett[13] were unable to produce pox in birds by the daily application of virus to the unbroken skin, nor did they succeed in bringing about infection by fixing to the leg pledgets of cotton soaked in virus. Fowls also resisted infection when

the virus was given to them in capsules. In experiments calculated to throw some light on the mode of transmission, these workers exposed healthy fowls to diseased ones under various conditions and in general they found that as long as picking was prevented the healthy fowls failed to contract the disease. Healthy birds placed in experimentally infected cages, or in cages vacated by diseased birds, failed to take the disease unless the comb or mouth mucosa had been previously scarified. Their findings led them to the conclusion that infection of the skin results from wounds sustained in fighting, and mouth lesions through injuries produced by eating grit. As a general rule, they believe that mouth lesions occur first and that comb lesions occur secondarily, after generalization of the virus. The preponderance of mouth lesions is considered by them as due to the greater liability of the site to injury. Pyle [19] also was of the opinion that the spread of pox was facilitated by injuries sustained in fighting. Brunet[20] placed a healthy pigeon, whose feathers had been plucked, with a diseased bird and obtained only a few tumors on the plucked bird. A healthy pigeon exposed at the same time failed to contract the disease, although it was known to have picked at the diseased bird. He was of the opinion that while contact was a possible means of contagion, it was probably not the natural one. Sweet[21] was inclined to believe that birds contracted the disease as a result of eating the pox scabs which fell from diseased birds.

The various theories regarding the mode of transmission do not explain the annual appearance of the disease in epizootic form. Surely the injuries resulting from picking and fighting do not explain the epizootic nature of the malady because picking is a common habit indulged in by young growing stock. And, if the disease follows the eating of scabs, it is difficult to explain the appearance of the disease in practically all the birds of a flock when there are no affected birds to furnish the scabs.

A most adequate explanation of the mode of transmission of fowl-pox is made possible as a result of the recent work done by Kligler, Muckenfuss and Rivers,[22] which showed that the disease could be transmitted by mosquitoes. They used two species of mosquitoes, *Culex pipiens* and *Aëdes aegypti*, and found that either was capable of transferring the virus from a diseased fowl to healthy ones. Lesions followed in from five to ten days after the infected mosquito was allowed to feed on a healthy fowl. The mosquitoes were found to be infectious immediately after

a meal from an infected fowl, so that they were considered as being only mechanical carriers of the virus. In one case a mosquito was still able to transmit the disease fourteen days after taking the infectious meal. Two healthy birds were placed in a mosquito-proof cage with a diseased bird and five recently hatched Culex. One of the exposed birds contracted the disease while the other was not affected, but was later shown to be immune to inoculation. When the experiment was duplicated in the absence of mosquitoes, no transmission resulted although the healthy birds were noticed to pick at the affected one. The exposed birds were later shown to be susceptible to the disease. Before this, however, Cary had suspected that pox was transmitted by mosquitoes, and Bice[23] reported, in 1928, that he was able to prevent fowl-pox by growing chickens in screened enclosures.

On the basis of transmission by mosquitoes, it is easy to explain the epizoology of this disease. In general, the disease is uncommon during the summer months. At this time the adult population is immune by virtue of a previous attack of the disease. The young stock, on the other hand, do not take the disease because of the lack of comb and wattle development—the points attacked by mosquitoes. Although the cockerels do develop these organs rather early in life, these birds are largely sold off as broilers. Furthermore, although mosquitoes are prevalent during the warmer months, the low incidence of disease does not permit them to become infected. However, a few cases of fowl-pox are always to be found and by feeding on these some mosquitoes undoubtedly become infected and transmit the disease to other susceptible birds which propagate the virus. From these cases, other mosquitoes become infected and in turn set up other foci of infection. This would account for the outbreaks of pox in growing stock still on the range. As the foci of infection increase, a correspondingly larger percentage of mosquitoes become infected so that during the fall and early winter months the disease reaches the epizootic stage. We need have no fear that the mosquito disappears with the approach of cold weather. In fact this undoubtedly forces them indoors and chicken-houses would not be excepted as shelter. I have seen large numbers of mosquitoes out of doors in Vineland, N. J., on December 1, and although a heavy snow fell after this, Dr. Black[24] was still able to collect mosquitoes.

After the disease has once been introduced, some transmission undoubtedly takes place without the aid of mosquitoes. In this instance injuries to the comb or mouth would serve as portals of entry for the virus. The outbreaks of pox in battery-brooded chicks, already referred to, was associated with injuries on the feet and in these places the lesions developed.

Obviously, the mucous membrane lesions cannot be attributed to the bites of mosquitoes. It is to be recalled, however, that these lesions usually occur late in the winter or in cold climates. Whether they are secondary to the cutaneous lesions, and persist because of secondary infection by bacteria, or whether they result from a different portal of entry is not known. At least they could develop secondarily if virus was carried by the blood to an injury on the mucosa before immunity had become established. With respect to lesions of the mucosa, Kligler *et al* suggest that bacteria may injure the mucosa and make it susceptible to pox infection.

The observed facts in connection with fowl-pox support the theory of transmission by mosquitoes. The disease is notably prevalent wherever mosquitoes are plentiful. Light breeds with large combs and wattles are more often attacked and more severely affected than heavy breeds with smaller exposed areas. The lesions usually occur on the areas not covered by feathers, yet the whole surface of the body is equally susceptible to the inoculated disease. The disease is more common in sections where the light breeds predominate and more uncommon in the Middle West, where heavy breeds make up a greater percentage of the poultry population. The tendency of the disease to appear at one place and spread in the direction of prevailing winds could be accounted for by assuming that the infected mosquitoes are carried in that direction. The appearance of the disease in turkeys with the development of the fleshy spots is suggestive that these areas furnish a point suitable for the attack of mosquitoes. The chipping sparrow has practically no exposed area except the feet and it is here that the lesions occur. The protection afforded by screening is also suggestive of an insect vector. Finally, the appearance of the disease in flocks reared from the day-old-chick stage on new ground and in new quarters is readily accounted for on the basis of transmission by mosquitoes or other insects.

Carriers

The spontaneous occurrence so characteristic of fowl-pox has suggested to some the possibility of a carrier. Doyle and Minett[13] infected birds in the mouth and on the comb, killed them in from seven to forty-four days afterwards, and attempted to establish the presence of the virus in the various tissues by inoculating these into susceptible birds. In no instance were they able to find the virus in the blood or elsewhere in the absence of active lesions at the time the bird was destroyed. Neither could they establish the survival of virus on the comb of inoculated birds after the lesions had disappeared.

The Virus

Cultivation: Only a few attempts to cultivate the virus of fowl-pox have been made. Lipschütz[25] failed to obtain multiplication on blood agar or in collodion bags in the peritoneal cavity of rabbits. More recently, Findlay[26] attempted to cultivate the virus in broth, fowl-serum broth, Harley's broth with and without the addition of fowl serum and chick embryo, defibrinated chicken blood and Bordet's potato-glycerin-blood-agar, but in no case did the virus survive longer than in Locke's solution at pH 7.2. However, by the use of tissue culture methods, he was able to carry the virus through four generations. A Berkefeld filtrate was placed in contact with the skin and brain of a chick embryo twelve to fifteen days old, for forty-eight hours in the ice-box. After removal from the box the mixture of embryo tissues and virus was distributed in flasks containing 5 cc of chicken plasma. Incubation was carried out at 37° C. Titrations were made before and after incubation and the virus was found to have multiplied in the first culture. Other flasks of the same medium were inoculated with material from the original culture and the virus continued to multiply as demonstrated by titration experiments. In flasks containing only chicken plasma the virus did not survive the four-day incubation period. As evidence of the specificity of the virus for ectodermal cells from the fowl, it was shown that the virus did not survive four days in flasks containing rat embryo skin and brain instead of that from the chicken.

Strains: The existence of more than one strain of virus would bring about serious complications in a program of control by vaccination. The possibility has been investigated by Doyle and Minett,[13] who immunized two fowls with their laboratory strain and two with the unknown strain and then tested each pair of

fowls for susceptibility to the opposite strain. In all, eleven strains were used, coming from outbreaks in which only the cutaneous or mucous membrane types were manifested, or a combination of the two. They could not establish the existence of more than one strain of virus.

Modification of virus: It is generally recognized that the virus of pigeon-pox can be transferred to the fowl but after a single passage the virus is no longer able to produce lesions in pigeons. Marx and Sticker,[2] Uhlenhuth and Manteufel,[3] and Haring and Kofoid[27] failed to produce pox in pigeons with a virus originating in fowls. In their preliminary experiments, Doyle and Minett[13] also failed to effect a transfer to pigeons, but they were finally able to adapt the fowl virus to the pigeon's skin. A pigeon inoculated on the leg was killed six days later and the inoculated area excised and an emulsion of it used to inoculate another pigeon. The process was repeated through nine pigeons, with the result that the bird of the second transfer showed a slight swelling of the feather follicles. Through successive passages to the fifth transfer, there was a progressive increase in the size of the feather follicles following inoculation, and, from the fifth transfer onward, the lesions were well defined. From the third to the ninth passage a portion of the skin emulsion was used to inoculate fowls which took the disease in every case. Six of the seven recovered and were found to be immune to subsequent inoculations practiced on the comb with a fowl virus.

Musselman was able to transfer the disease of the feet of chipping sparrows, providing material for inoculation was collected during the bleeding period; scab material appeared to be no longer infectious. This suggested that the virus had become modified in its passage through sparrows. The virus responsible for the disease in quail produced typical lesions in chickens but these were more attenuated than those produced by fowl virus. Berkefeld filtrates of the quail virus were not active, which suggested the possibility to Gallagher that the virus had become modified. In the outbreak of pox in turkeys, cited by Jowett,[28] the disease did not spread to the common fowl and Jowett thought this to be an indication of its modification.

Virus bodies: The so-called inclusion bodies observed by Bollinger, in 1873, and variously considered by others as protozoa, products of degeneration, or the virus itself in combination with other elements, have been studied more recently by Goodpasture. In 1907, Borrel[29] observed that these fowl-pox cor-

puscles broke up to form a large number of very small isolated elements. These had the form of micrococci, diplococci, streptococci or staphylococci. Loeffler's flagellar stain revealed a kind of mucous envelop around each element. Borrel called attention to the striking resemblance of these to microbial elements. The regular aspect and dimensions of these bodies seemed not to favor the hypothesis of their being a precipitate. v. Betegh,[30] who appears to have observed the same bodies, considered them as probably filtrable. Goodpasture was struck by the morphological similarity between the Borrel bodies and living organisms. Scrapings made from the surface of lesions showed the corpuscles containing myriads of the minute bodies (Borrel bodies) held together by a viscous material. The minute bodies exhibited marked Brownian movement. Only recently Woodruff and Goodpasture[31] showed that the corpuscles could be freed from their surrounding tissue by digestion in a one per cent trypsin solution in 0.2 per cent sodium bicarbonate. By means of a Chambers micro-dissection apparatus they were able to isolate the fowl-pox corpuscles and wash them free of debris. Then by inoculating a single corpuscle they were able to produce a pox lesion in a feather follicle. The material freed of the corpuscles was not infectious. As a result of these findings they consider the inclusion body, so-called, as a collection of organisms. They speak of these with confidence as virus bodies rather than inclusion bodies.

Immunity

It is generally agreed that an attack of fowl-pox is followed by an immunity of variable duration. Lipschütz was able to produce an immunity in some birds by the subcutaneous inoculation of one-cc doses of a relatively thick suspension of virus. A few animals, however, reacted to a later infection. Manteufel[32] showed that a subcutaneous or intravenous inoculation of virus always produced an immunity even though no local manifestations resulted from the first inoculation. He interpreted this to mean that immunity could be obtained from the subcutis. In some cases, however, the reaction was severe and extensive lesions developed. Hens immune to local inoculation did not show general disturbances when infected subcutaneously or intravenously and he considered this as an indication that skin immunity was not of histogenic nature but merely a symptom of general immunity. According to Brunet, the degree of immunity

established by inoculation depends upon the degree of eruption. He also observed that inoculation of partially immunized birds was followed by eruptions which disappeared in three days, while in susceptible birds these persisted for three to four weeks. In order to determine the time at which immunity is established, Brunet inoculated pigeons and then re-inoculated them in 5, 8, 12, 14 and 20 days, respectively. He found that the disease produced by a second inoculation, eight days after the first, ran a shorter course, and that produced by an inoculation twelve days after the first, disappeared in five to six days. Inoculations fourteen days after the first produced only slight tumefactions but no true eruption. By the twentieth day, immunity was established so that a second inoculation at this time was not followed by the appearance of lesions. Manteufel recognized a variation in virulence in different strains of virus, and that some strains were so weak that they did not produce lesions upon inoculation, yet such fowls were said to be immune to inoculations with virulent virus. He did not, however, determine the duration of such immunity. Brunet was of the opinion that the serum of hyperimmunized fowls or pigeons had some protective action but virus in contact with serum was not destroyed after three days, and would continue to produce lesions when inoculated. Manteufel found that immune serum was of no therapeutic action even when given repeatedly in relatively large doses. He was able to confirm Brunet's observation that immune serum had no action on virus *in vitro*. That it did have some action *in vivo*, however, was suggested by the fact that inoculations of virus and immune serum did not confer immunity, whereas immunity was produced in fowls inoculated with virus and normal serum. This worker, as well as many others, have been able to show that immunity cannot be produced by the injection of virus inactivated by heat or exposure to disinfectants.

Vaccination

It is generally accepted that artificial immunization against a virus disease, with few exceptions, cannot be effected without the use of an active virus. Thus far, all attempts to immunize fowls with an inactivated virus have failed. It appears to be definitely established also that the degree or duration of immunity against fowl-pox resulting from an attack of the disease, acquired naturally or artificially, is proportionate to the extent of the eruptions which develop. Finally, although a living virus may

be employed and in a sufficiently large dose, immunity may not be established by failure of the virus to reach the tissue for which it has an affinity. Thus, in order to produce an immunity against fowl-pox of sufficient duration to make the procedure warrant adoption, it is necessary to employ an active virus in such a manner and in a sufficient dose to bring about lesions of reasonable extent. On this basis one may evaluate a vaccine as an immunizing agent.

The immunizing properties of the vaccines used by the earlier investigators in the country were judged largely from the results of field experiments, mostly on infected flocks. In many cases non-vaccinated controls were not maintained. The potency of the vaccine was not determined before its application. In some instances the product was used so long after its production that it could not have been active, and finally, the method of application might not have enabled the virus to reach the proper tissues. Hadley and Beach[33] employed a product which had been heated to 55° C. for an hour. The emulsion had been passed through cotton before heating, so that the virus contained in the fine particles must have been almost, if not completely, destroyed. They did not determine the potency of the product and no statement is made as to the length of time it was held before being used. The agent was inoculated subcutaneously, and if there was any local reaction they failed to observe it. The only tests for immunity made in the laboratory on vaccinated birds certainly did not warrant the conclusion that immunity had been established. The product used by Mack and Records[34] was similar to the one used by Hadley and Beach.[33] No control birds were left in the vaccinated flocks. The product, at least on one occasion, was used three months after its production and, inasmuch as it was not preserved in glycerin, there is no reason to suppose that it was active. Brumley and Snook[17] did not even include the virus in their vaccine except that which might have been in association with the organisms used in making the bacterin. This product might have been of some value in controlling the conditions due to secondary invaders, but it could not have served as a prophylactic agent.

Beach[35] used only the pox scabs in making a vaccine and did not include the diphtheritic membranes, as was the usual practice. The product made by him was not only heated for an hour at 55° C. but was also preserved with 0.2 per cent tricresol. The vaccine was stored at 7° C. and was apparently used in a

comparatively short time after preparation. Beach realized that a vaccine which caused lesions when applied to the scarified comb was a better immunizing product than one which produced only mild lesions. Vaccinated birds were tested for immunity, and while some were immune, others showed only a partial immunity. Still others developed no immunity at all. Boerner and Stubbs[36] obtained negative results with a vaccine prepared after the method of Hadley and Beach.[33] Other tests made by them with a vaccine obtained from J. R. Beach also failed to give results when used on infected flocks.

The method of vaccination brought out by de Blieck and v. Heelsbergen was an improvement in that the virus is brought in direct contact with the skin. These investigators claim that their product is a modified virus, but the findings of Doyle[37] do not indicate this. Judging from his results it would appear that some samples of the vaccine are so attenuated that they are no longer capable of producing lesions when applied to the scarified skin, and consequently possess no immunizing value. Other samples appear to have been made from material having a high degree of virulence.

Johnson's method of vaccination was to apply an emulsion of an unattenuated virus to the feather follicles. The potency of the product was evidenced by the fact that scabs formed at the inoculation point. Although Johnson did not determine the duration of immunity established, it is reasonable to suppose that the lesions were sufficiently extensive to produce an immunity of long duration.

In 1927, Beach[38] reported on extensive studies made on vaccines containing unattenuated virus. The vaccines used by him were prepared in various ways and used at varying intervals after preparation. His method of approach was to determine the potency of the product before using it in immunization experiments. The immunized birds were tested for susceptibility at twenty-eight days, and in other cases after a longer interval. The occurrence of vaccination-point lesions was noted and he showed that the development of these was a fairly reliable index that immunity would be established. Beach determined that the maximum growth of scabs occurred by the twelfth day after inoculation, and that scabs collected at this time furnished a superior product for a vaccine on the grounds that its potency was maintained for a longer period, and a higher percentage of fowls became immunized as a result of its use. His laboratory

experiments indicated that immunity is established by the twenty-eighth day. The duration of immunity was tested in a series of birds vaccinated under field conditions. The flocks had been vaccinated with products varying in age so that the duration of immunity was found to depend very much on the age of the vaccine at the time it was used.

After a careful consideration of the results thus far published, one cannot avoid the conclusion that in the strictest sense, we do not have a vaccine for fowl-pox. That is, since an inactivated virus will not produce an immunity and since no one has been able to produce a modified virus we must resort to the use of the active virus. In order for immunity to become established one must actually produce in the bird to be immunized the equivalent of the natural disease. The subcutaneous inoculation of virus may be followed by only a small lesion but nevertheless this differs from the natural disease only in respect to the extent and location of the lesion. Although Beach seems to have demonstrated that immunity may follow subcutaneous inoculation in the absence of visible vaccination-point lesions, the fact remains that no one can say that the virus did not multiply in the tissues to some extent. By his own results he shows that in cases where vaccination-point lesions do not develop, immunity may not become established. Since the subcutaneous injection of virus may not be followed by vaccination-point lesions and since this in turn may not be followed by immunity, there seems to be no advantage in this method of inoculation. The small lesion that does develop may be considered as an advantage, but this may be at the expense of a more lasting immunity. The same dose of virus applied directly to the skin would undoubtedly produce a sufficiently extensive lesion to stimulate a lasting immunity. Therefore, there is no reason why one should hesitate to apply virulent material to the skin and actually produce fowl-pox differing from the natural disease only with respect to the location of the lesion. By this method, the disease is produced at such a time when it will not interfere with egg-production. Thus, the method used by Johnson appears to satisfy all the requirements necessary for the production of an immunity of sufficient duration.

Our limited experience with this method completely confirms the findings of Johnson. The product used by us is nothing more than a suspension of powdered fowl-pox scabs in a 50 per cent glycerin solution. We have used as much as 2 grams of

ground scabs to 25 cc of the vehicle, which is considerably more than that used by Johnson. At the present time we are using 1 gram of powdered scabs to 40 cc of the solution. The reaction produced in birds just coming into production is quite severe. Egg-production ceases almost entirely and between the second and third weeks after vaccination, the flock may present rather grave symptoms, but in spite of this, the mortality is negligible. We have not, however, vaccinated birds which were in heavy production. The application of virus to birds only ten weeks of age produced no ill effects beyond a transient loss of appetite between the second and third weeks.

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State Board Changes

Dr. Fred R. Whipple, of Chicago, has been appointed a member of the Illinois State Board of Veterinary Medical Examiners. The other members of the Board are: Drs. C. O. Kroener, of Chicago, and L. A. Merillat, of Evanston.

The Illinois ruling on reciprocity enables veterinarians from other states to obtain licenses to practice in Illinois without taking the written examination, provided that the states from which the applicants secured their licenses extend the same concession on equal terms to the Illinois Board.

Applicants for licenses on a reciprocity basis must furnish information to the effect that they have practiced for five years and that they are members of their state, local or national association; they must come before the Board in person and in each case must be recommended by the examining board which granted the license presented for reciprocal consideration. The object of this ruling is to enable the Board to extend the courtesies of the State to other boards and to worthy practitioners. Applications for licenses should be made to the Director of the Department of Registration and Education, at Springfield.

The personnel of the reorganized New Jersey State Board of Veterinary Medical Examiners is as follows: Dr. W. F. Harrison, Stockton, President; Dr. H. C. Millar, Asbury Park, Treasurer; Dr. W. B. Maxson, Flemington, Secretary; Dr. P. B. Silvester, Princeton; and Dr. A. D. Goldhaft, Vineland.

A law passed by the Legislature of Wisconsin at the recent session abolishes the Wisconsin State Board of Veterinary Medical Examiners. Under the new law, the licensing and the registration of veterinarians will be in the hands of the Board of Commissioners of Agriculture, at Madison. It has not yet been determined just what arrangements will be made for holding examinations for licenses to practice.

ABORTION DISEASE IN THE FOWL*

By M. W. EMMEL *and* I. FOREST HUDDLESON

Michigan Agricultural Experiment Station
East Lansing, Michigan

Dubois,[1] in 1910, reported what appeared to him to be an epizootic of both an acute and fulminating nature among farm flocks of fowls caused by *Brucella melitensis*. His diagnosis was based on his ability to diagnose the presence of the infection in sheep on the same farms and on the finding of specific agglutinins in the birds' blood in dilutions ranging from 1 to 50 to 1 to 600.

Zwick and Zeller,[2] in 1920, were unable to produce infection in the fowl by repeated subcutaneous, intraperitoneal, intravenous and intramuscular injections of *Brucella abortus*.

Koegel,[3] in 1923, attempted to produce infection in the fowl and pigeon by injecting and feeding large doses of *Br. abortus*. He found agglutinins present in the birds' blood in titers varying from 1 to 200 to 1 to 1000 but was unable to find any outward manifestations of disease.

In view of the fact that no experimental studies have ever been made to determine the susceptibility of the fowl to the melitensis and suis species, experiments were instituted for this purpose which also included *Br. abortus*. These organisms were isolated from animals, as well as cases of undulant fever in man.

A total of forty-eight birds of various breeds were used in the experiments. Milk from the infected udder of a cow, portions of an aborted fetus, and pure cultures of the organisms served as sources of infection. Most of the birds were exposed by feeding while a few were injected intravenously.

Infection was produced in most of the experiment birds. Death resulted in many cases, recovery resulted in a few, while others were killed at intervals in order to study the various phases of the disease.

The clinical symptoms manifested throughout the course of the infection were very constant. The birds first went off egg-production and usually developed severe diarrhea. A gradually increasing paleness about the head, comb, and wattles, and emaciation occurred. Before death the birds became very weak

*Presented at the sixty-sixth annual meeting of the American Veterinary Medical Association, Detroit, Mich., August 13-16, 1929.

and often showed paralysis. The course of the disease ranged from 18 to 96 days.

The macroscopic lesions vary considerably, depending on the rapidity of the course of the disease. The spleen at the onset usually becomes greatly enlarged and congested, after which it atrophies and at death is usually very small.

The liver becomes mottled and pale and may show small, light-brown or gray foci on its surface. At death the organ is very friable and extremely pale.

The kidneys first show cloudy swelling, followed by congestion, and return to normal size, after which there is a marked paleness of the organ.

The lungs appear normal at all times.

The ovaries were always in a non-functional state and invariably showed degenerative changes in which the ova became flaccid and dirty yellow in color.

Necrotic enteritis with numerous irregular elevated areas of cellular infiltration prevailed in the duodenum. In many birds at death there were irregular patches of almost complete necrosis of the mucosa in the middle portion of the intestinal tract. While there is a marked consistency in the character of the microscopic lesions found in all of the organs, often they differ in their ability to be discerned by the naked eye. This is particularly true of the lesions of the liver.

The agglutination test was found to be a good index of infection although a negative test was not necessarily a criterion of the absence of infection. During the last stages of the disease all birds with the exception of one showed a negative agglutination titer. This period of non-reaction may last from two to five weeks before death.

Four flocks were found in which natural infection occurred. Three of these flocks had a history of decreased egg-yield. Twenty per cent of these birds reacted to the agglutination test. A study of sixteen birds from these flocks was made. Many of them showed clinical manifestations of the disease and characteristic lesions at autopsy. All of them showed microscopic lesions similar to those found in the experiment birds.

Although death may occur in many instances from Brucella infection, we believe it to be chiefly of economic importance from the standpoint of egg-production. All of the experiment birds and those examined from naturally infected flocks showed inactive and degenerative ovaries. The naturally infected flocks

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Although death may occur in many instances from Brucella infection, we believe it to be chiefly of economic importance from the standpoint of egg-production. All of the experiment birds and those examined from naturally infected flocks showed inactive and degenerative ovaries. The naturally infected flocks

all had a history of decreased egg-yield. If recovery from infection takes place, it usually is very slow and often requires from four to six months for the birds to again become productive.

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DISCUSSION

DR. C. P. FITCH: How widely distributed was the infection in these four naturally infected flocks?

DR. EMMEL: In all four of these flocks there was an average of twenty per cent of the birds reacting to the agglutination test, at dilutions varying from 1 to 25 to 1 to 100.

DR. FITCH: You called a reactor any bird which gave a titer of 1 to 25?

DR. EMMEL: Yes, in every bird giving a reaction in a dilution of 1 to 25 we always found typical microscopic lesions.

DR. FITCH: Was the organism isolated from the naturally infected birds?

DR. EMMEL: No, that is a little different story. I will tell you about this first flock. It consisted of about 700 birds. Three birds were sent to the laboratory for diagnosis. We had been working with this disease and they appeared very suspicious. We blood-tested them and found that they gave a positive agglutination test. We got the history of the flock, examined the birds microscopically, and while we were never able to satisfy ourselves as to the source of the infection we were satisfied that we were dealing with abortion infection. This man had lost about thirty birds and twenty-five more were sick. The organism was isolated from one of the birds sent to us.

It seems that the isolation of the organism is rather difficult. We isolated the organism from about twelve of the experiment birds. We attributed this to the fact that in the fowl the organism is not present in sufficient numbers to be readily isolated. This would be borne out also by the fact that there is a predominance of perivascular lesions, especially in the liver and spleen. While these lesions are typical of toxins, I do not believe that anyone has ever demonstrated that any of the species of the genus Brucella produces a toxin. We, therefore, attribute the lesions to the fact that there is a slow entrance of the organism into the system. The fact that the disease usually lasts over a long period of time would also contribute to this theory.

MEMBER: Do you find any macroscopic lesions in the ovary characteristic of the disease?

DR. EMMEL: No. I have been working on some of the degenerative changes that take place in the ovary and I find that there is a very striking similarity in the degenerative changes in all diseases where the ovary is involved. None of these diseases can be distinguished macroscopically in the ovary with the possible exception of bacillary white diarrhea.

MEMBER: Is diarrhea one of the symptoms?

DR. EMMEL: It usually is, in the early stages. It may disappear to some extent as the bird emaciates, but may be present to a considerable degree at death.

DR. F. C. TUCKER: I am wondering how a practitioner could recognize this disease.

DR. EMMEL: It is very difficult to recognize it from the macroscopic lesions, but these lesions, taken together with the history and the clinical symptoms, should lead you to be very suspicious of the disease after other possible diseases have been eliminated. The agglutination test should have some value in testing naturally infected flocks.

DR. FITCH: Have you made any routine examinations of blood?

DR. EMMEL: That is how all this came about. Doctor Stafseth was getting blood samples for the B. W. D. test and Dr. Huddleson started to test these samples for abortion. I don't remember exactly what percentage he found to be infected with abortion but he found quite a few. The percentage, of course, would vary considerably with the flock.

SOME OBSERVATIONS ON THE PATHOLOGY OF BACILLARY WHITE DIARRHEA IN BABY CHICKS

By HUBERT BUNYEA *and* WALTER J. HALL

Pathological Division, U. S. Bureau of Animal Industry, Washington, D. C.

The idea that bacillary white diarrhea may be readily recognized by the presence of certain gross lesions which may be observed upon autopsy of baby chicks seems more or less prevalent. Diagnostic value is more particularly ascribed to the ochre-colored liver and the retained or unabsorbed yolk. That the scientific literature is not wholly without responsibility for this popular notion is to be inferred from the emphasis given in the literature to these findings mentioned as being prominent indications of bacillary white diarrhea infection of baby chicks.

Jones,[1] in 1911, reported that the unabsorbed yolk was the most characteristic lesion of bacillary white diarrhea in baby chicks. In 1924, Beaudette called attention to the yellow livers and unabsorbed yolks found in the disease. Ward and Gallagher[2] state that "the failure of the yolk to be absorbed is the principal abnormal condition that is present," and that "the liver usually shows an ochre color, with bands or streaks of congestion." They concede, however, that these lesions are neither constant nor entirely specific. According to Reinhardt[3]:

> The liver is swollen, yellowish brown, and the gall-bladder engorged. The spleen and kidneys are swollen. In chicks dying in the first few days the yolk is found to be anywhere from its original size to that of a pea. Its unabsorbed content is yellow, brownish green, or even blackish, and of a gelatinous, watery, or cheesy consistency.

Dearstyne *et al*[4] ascribe diagnostic significance to the fact that "the liver may be yellowish brown," and "the abdominal yolk may present various degrees of absorption and degeneration." To quote Schilling and Bleecker[5]:

> That the amount of yolk found bears some relationship to the health of the chick or to the pathological condition which it may present has for a long time been surmised.

These investigators autopsied 75 normal chicks killed at various ages from 72 hours to 9 days, and weighed the unabsorbed yolks which were encountered. Their own comment on this experiment in part is as follows:

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> Wide differences were observed in the individual rates of utilization of the reserve yolk, unaccompanied by observed pathological changes or bacterial interference. . . . Up to the fifth day considerable masses of unabsorbed yolk may usually be found, and an infectious or other pathological state is not predicated even on the presence of yolk masses weighing up to four grams on the seventh to ninth days.

In connection with other studies of bacillary white diarrhea, the writers have had occasion to perform autopsies and bacteriological examinations upon more than 1,000 baby chicks not more than 14 days old, about 80 per cent of which showed the presence of *Salmonella pullorum*. Cultures were made from the livers, lungs and yolks not absorbed. It should be stated that in the beginning some trouble was experienced with gross contamination, so that a slight possibility of error exists in the fact that some few chicks actually dying of *S. pullorum* infection might have gotten into our records as pullorum-negative. This difficulty was soon overcome, however, and we are confident that except for this almost negligible possibility of error our records are reliable.

The organism of bacillary white diarrhea is not always recovered with equal facility from all tissues examined. Sometimes it will be found in one organ and not in another. In culturing retained yolks it is noteworthy that a remnant of unabsorbed yolk as small as a grain of wheat has sometimes been found to contain the organism in immense numbers. Lung cultures more than any others have been contaminated with various types of organisms.

In our studies we have assumed that, when *S. pullorum* was recovered from a chick, death was due to bacillary white diarrhea, and vice versa, when the germ was not recovered, that the chick was not infected with *S. pullorum* and that, therefore, death was due to some other cause. The interpretation of the findings in these autopsies was made upon this basis.

At least two more or less distinct types of infection were noted:

(1) A chronic pulmonary type, in which death occurred from the sixth to the fourteenth day, and in which necrotic foci were found in the lungs and heart, possibly indicating respiratory infection in the incubator.

(2) A chronic intestinal type, in which death occurred from the sixth to the fourteenth day, and in which necrotic foci were observed principally in the large intestine, indicating probable infection by ingestion.

Besides these a considerable number of cases were observed in which death occurred in the shell or soon after hatching, and in

which no macroscopic lesions were present. In view of these negative findings we do not concur in the opinion of Doyle and Mathews[6] that "the disease can usually be diagnosed solely by the gross lesions."

The intestinal type of infection occurred in but a few instances in our experiment, perhaps because of the unusually sanitary brooding conditions provided for our work. A special type of experimental brooder was designed for this experiment, the essential features of which consist of a wire-cloth floor, externally located receptacles for food and drinking-water, and all-metal construction.

Figure 1 shows the mortality curve, *by numbers of chicks*, during an observation period of 14 days. Of the chicks studied

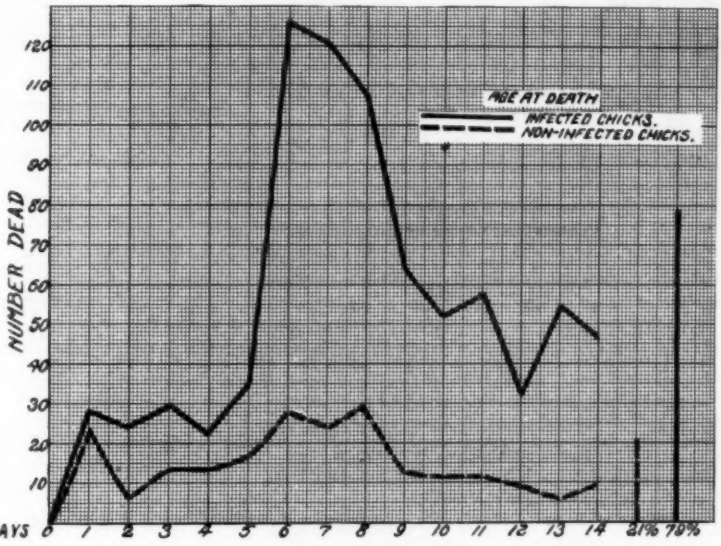

FIG. 1. Graph showing age of greatest mortality of infected and non-infected chicks.

S. pullorum was isolated from 79 per cent, while from 21 per cent this organism was not recovered.

It appears that in the pullorum-negative chicks heavy mortality began the first day and commenced to recede after the ninth day, whereas among the pullorum-positive chicks, the number of deaths was not particularly high until the sixth day, but continued with only slight abatement until the fourteenth day, when observations were discontinued.

Complete tabulations which were made of the liver, lung, yolk and heart lesions, observed by ages in the chicks dying at from

1 to 14 days of age, yielded the following significant facts with reference to these chicks:

(1) The occurrence of pale, ochre, or mottled livers was observed principally in younger chicks, not appearing to any appreciable extent after the seventh or ninth day.

(2) Unabsorbed and partly absorbed yolks were noted as persisting in most cases for about the same length of time; if anything, tending to persist longer in pullorum-positive than in pullorum-negative chicks, though not so frequently noted in the former as in the latter.

(3) Necrotic lesions in the lungs and heart did not appear to any great extent before the sixth day, and were most noticeable from then until the fourteenth day. Lung congestion and pneumonia were observed indiscriminately as far as age was

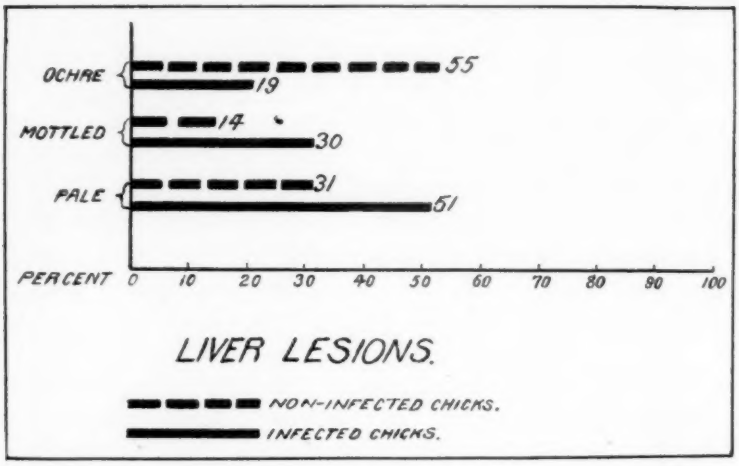

FIG. 2. Frequency of occurrence of various lesions in livers of non-infected and infected chicks.

concerned, up to about the tenth day for pullorum-negative chicks and the thirteenth day for pullorum-positive chicks.

(4) The writers believe that the tabulations indicate that the often-cited pale or ochre liver and unabsorbed yolk are not pathognomonic of bacillary white diarrhea of chicks, but that the focal necrosis of the heart and lungs, or of the intestinal wall, is specifically pathognomonic of chronic forms of the disease. In general our observations have corroborated those of Doyle and Mathews,[6] particularly with reference to the nodular lesions upon the hearts and lungs of pullorum-infected chicks. However, these investigators found the liver to be the most constant seat

of gross lesions, consisting of focal necrosis. They sometimes found in chicks, only a few days of age, an acute hemorrhagic pneumonia which they regarded as a lesion of the disease. They also observed caseous impaction of the ceca to the exclusion of other intestinal lesions. Our experience does not coincide in the above particulars with theirs.

To bring out the facts more fully, a series of diagrams has been prepared showing the relative occurrence of the principal lesions in the liver, lungs and heart, as well as the degree of absorption of the yolk in pullorum-negative and pullorum-positive chicks, as observed by us.

Figure 2 is a diagram of the frequency of liver lesions in pullorum-negative and pullorum-positive chicks. It is shown that,

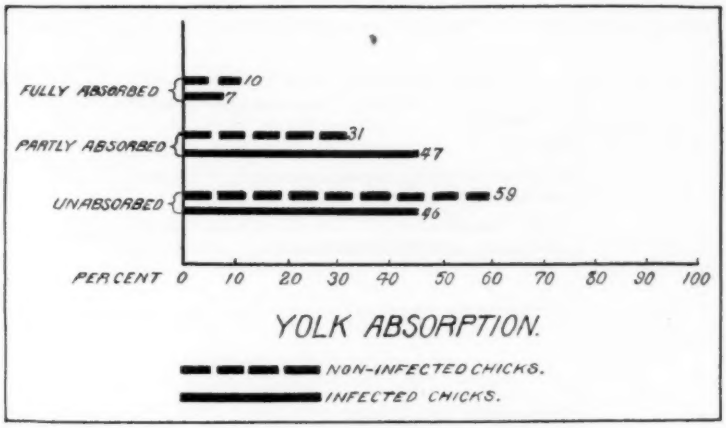

FIG. 3. Frequency of absorption or retention of yolk in non-infected and infected chicks.

far from being a lesion of bacillary white diarrhea, the ochre liver occurred in only 19 per cent of the pullorum-positive cases, and in 55 per cent of the pullorum-negative cases. Mottled and pale livers occurred with less frequency in pullorum-negative than in pullorum-positive chicks, but are not regarded as significant, as far as diagnosis is concerned.

Figure 3 illustrates yolk-absorption with relation to the infection. Complete absorption occurred in a small percentage of both pullorum-negative and pullorum-positive chicks, and partial absorption in a slightly larger percentage of the latter than of the former. The outstanding feature of this chart, however, is the fact that while 59 per cent of pullorum-negative chicks showed non-absorption of the yolk, only 46 per cent of the pullorum-

positive chicks displayed this condition. This cross-section of evidence from more than 1,000 chick autopsies would seem to discredit the supposed pathognomonic relationship of unabsorbed yolks to bacillary white diarrhea of chicks.

Figure 4 shows the relative frequency of the occurrence of certain pathological changes in the lungs of pullorum-negative and pullorum-positive chicks. Pneumonia and congestion of the lungs were more prevalent in pullorum-negative than pullorum-positive chicks, and were not regarded as being primarily related to the disease. In this regard our findings are somewhat at variance with those of Dearstyne, Kaupp and Wilfong, who, though they recognize the pathognomonic nature of the "white or whitish-yellow millet-seed-like nodules in the lung substance," go further in averring that "a well-defined pneumonic condition"

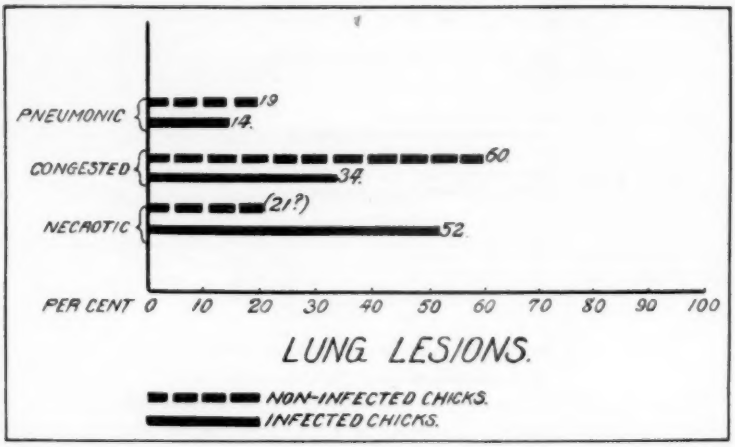

FIG. 4. Frequency of occurrence of lesions in lungs of non-infected and infected chicks.

is to be associated with bacillary white diarrhea. The presence of circumscribed necrotic lesions varying in size from a pin-point to a grain of rice has been observed in 52 per cent of the pullorum-positive chicks autopsied, all but 11 of which were from 6 to 14 days old. These lesions in some cases coalesced to form nodules the size of a pea or even to involve practically an entire lung. It is thought that occurrence of these lesions in 21 per cent of apparently pullorum-negative chicks may be a possible error attributable to the fact that these cases all yielded an overgrowth of contaminating organisms that obscured the possibility of recognizing *S. pullorum* as present. By the use of brilliant-green agar, as recommended by Mallmann *et al*,[7] for the inhibition

of troublesome contaminations, it might be possible to establish more conclusively the pathognomonic status of the necrotic lung lesions for bacillary white diarrhea. Similar necrotic lesions varying greatly in size were observed in the epicardium and myocardium, producing an irregular, nodulated appearance on the surface of the heart. The age at which these lung and heart lesions begin to prevail in chicks exposed to infection, as well as the location of the lesions, suggest that the lesions may belong specifically to an air-borne form of the infection.

Figure 5 serves to illustrate diagrammatically the relative frequency of the occurrence of the above-mentioned lesions in the liver, heart and lungs of pullorum-negative and pullorum-positive chicks. Liver lesions, in general, are noted as being

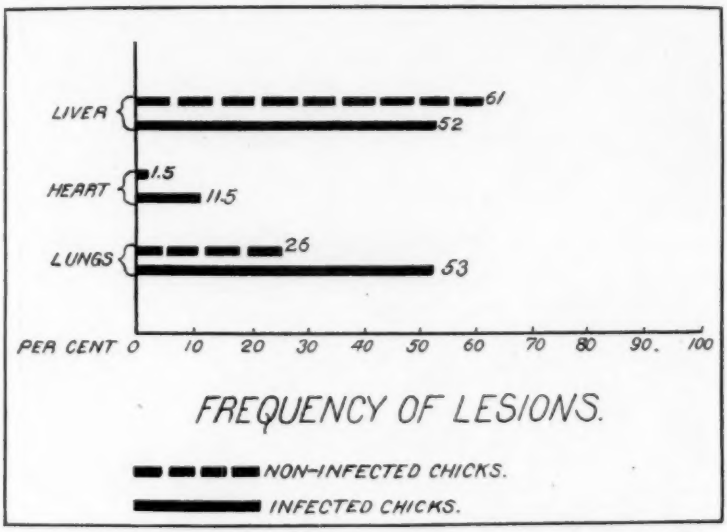

FIG. 5. Occurence of lesions in liver, heart and lungs of non-infected and infected chicks.

more prevalent in pullorum-negative than in pullorum-positive chicks, whereas heart and lung lesions occurred more often in pullorum-positive chicks. The 1.5 per cent of heart lesions recorded against pullorum-negative chicks consisted of three cases of necrotic heart in chicks yielding overgrowths of contaminated cultures. These may actually have been cases of bacillary white diarrhea, as has been suggested in the case of lung necrosis in pullorum-negative chicks. The bulk of the lung lesions noted against pullorum-negative chicks consisted of congestion and pneumonic lesions, both already shown to be non-pathognomonic for bacillary white diarrhea.

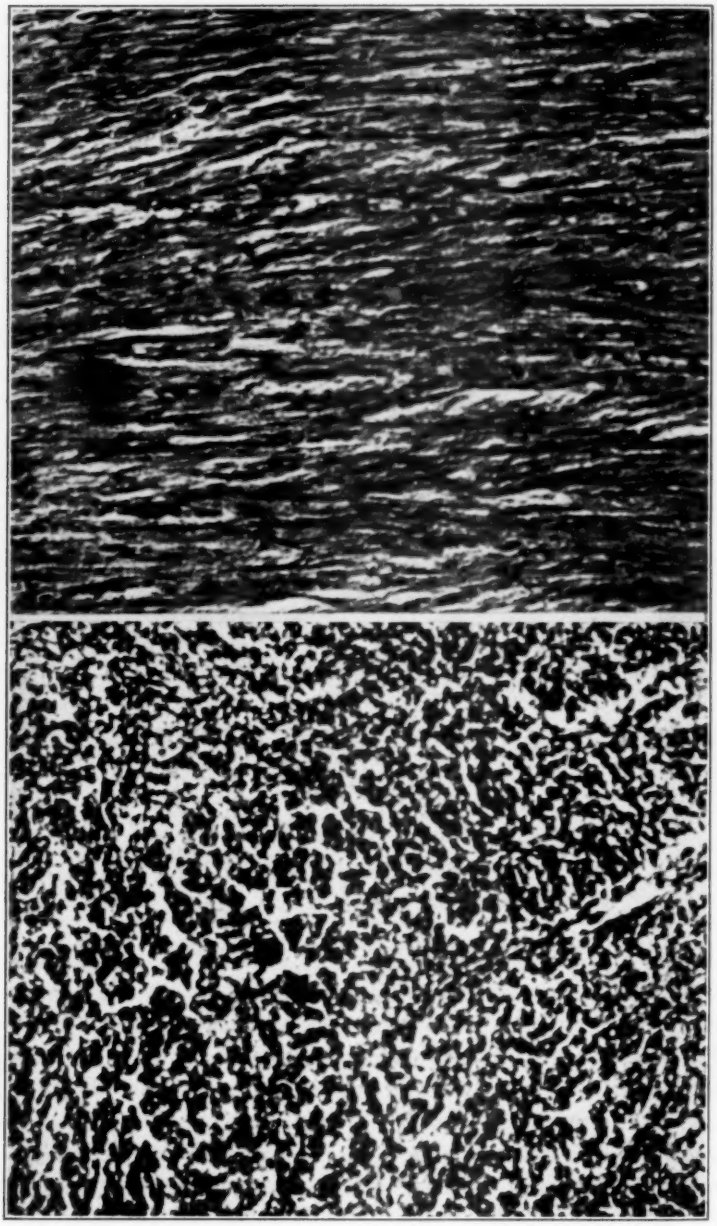

FIG. 6. (Above) Normal chick heart muscle. x 230.

FIG. 7. (Below) Heart muscle from chicken affected with bacillary white diarrhea. x 230.

Brief mention will now be made of the histo-pathological findings which are of most outstanding importance in the study of the lesions of the heart, lung and intestine of bacillary-white-diarrhea-infected chicks.

Figures 6 and 7 show microscopic sections of normal and diseased heart muscle respectively. By contrast it will be seen that in the pathological section there are shown extensive necrotic areas characterized by cloudy swelling and degeneration of muscle fibers.

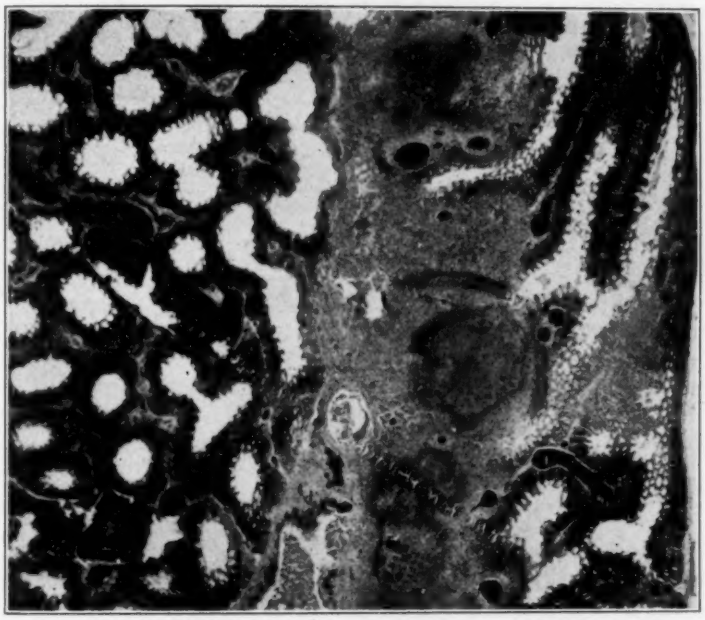

FIG. 8. Lung of chick affected with bacillary white diarrhea, showing both normal and pathological areas. Cross-section. Magnification ca. x 20.

Figure 8 shows a low magnification of the lung of a bacillary-white-diarrhea chick, illustrating both normal and pathological areas. The homogeneous, lightly stained portions represent the abscessed or necrotic areas involving both parenchymatous and interstitial tissues. Adjacent structures show varying stages of degeneration in which the alveolar sacs are largely obliterated by hypertrophy of the interstitial connective tissue and by filling up of the alveoli with fibrin and leucocytes, and by desquamation of the alveolar epithelium.

Figures 9 and 10 are photomicrographs respectively of normal and diseased large intestine of baby chicks. The pathological

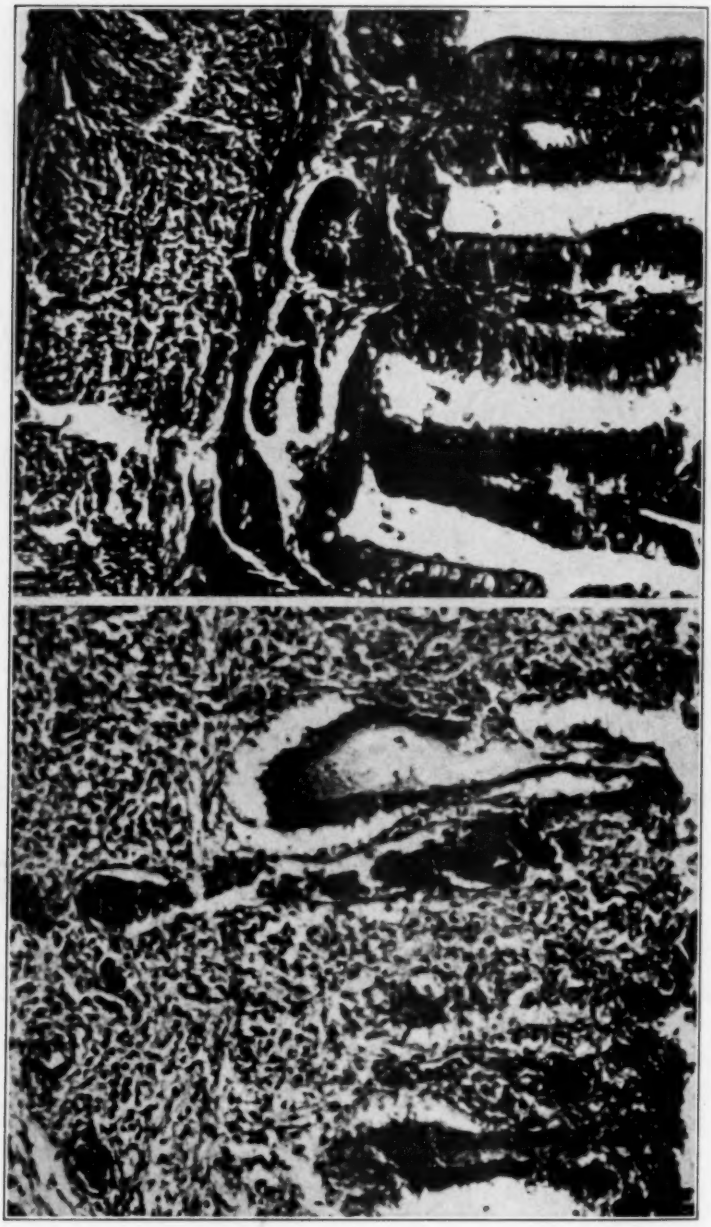

FIG. 9. (Above) Large intestine of normal chick. Longitudinal section. x 230.

FIG. 10. (Below) Large intestine of chick affected with bacillary white diarrhea. Longitudinal section. x 230

section shows varying degrees of erosion of the mucosa, with accompanying desquamation of glandular epithelium, and in some areas the total disappearance of the intestinal villi. The submucosa exhibits marked thickening, and the muscular coats give evidence of degeneration. The lumen of the intestine is occluded with a white caseous cast consisting of cell detritus, desquamated epithelium, polymorphonuclear leucocytes, and glandular epithelium.

Summary and Conclusions

Pathological changes in the liver, such as a mottled, pale, or ochre color, do not appear to be pathognomonic of bacillary white diarrhea of chicks.

Partial or complete non-absorption of the yolk substance is not pathognomonic of the disease.

A high mortality in the first few days after hatching was not particularly characteristic of the disease, as we observed it.

An abrupt rise in the number of deaths on the sixth to eighth days after hatching, followed by a considerably decreased yet abnormally high mortality up to two weeks of age, is very suggestive of bacillary white diarrhea infection.

Necrotic spots in the lungs seem to have considerable diagnostic significance. These lesions, together with similar lesions on the musculature of the heart, appear to represent a form of bacillary white diarrhea infection acquired by inhalation. Though 21 per cent of necrotic lung lesions and 1.5 per cent of necrotic heart lesions are recorded in pullorum-negative cases, these cases are open to some question.

The presence of gross intestinal lesions such as thickening and necrosis of the large intestine are indicative of infection by ingestion, and suggest brooder infection rather than incubator infection.

The frequent absence of any gross lesions in acute forms of bacillary white diarrhea in baby chicks necessitates recourse to bacteriological procedures in diagnosing the disease with certainty in many cases.

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THE EFFECT ON HEALTHY PULLETS OF PREVENTIVE VACCINATION AGAINST CHICKEN-POX

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Vaccination against chicken-pox has been extensively practiced in some sections (particularly in California) for several years. The vaccine which has been most extensively used consisted of a suspension of attenuated chicken-pox virus. It could not be relied upon to produce complete or lasting immunity and was, therefore, of value principally as an aid in controlling outbreaks of chicken-pox rather than as a means of immunizing healthy flocks against subsequent infection. Since chicken-pox usually occurs after fowls have reached laying age, the loss resulting from an outbreak of the disease is often as great from decreased egg-production as from the disease itself. It has long been recognized, therefore, that a method of safely and effectively immunizing young birds against this very prevalent disease would be a great aid to profitable poultry-raising.

During recent years experiments in this and other countries have developed new types of vaccines and methods of vaccination whereby young fowls can be actively immunized against chicken-pox. The vaccines developed differ somewhat in method of preparation, but all contain *living virulent chicken-pox virus* upon which their immunizing property depends. Two methods of administering the new types of vaccine have been used, *i. e.*, the *subcutaneous* and the *cutaneous or feather-follicle-infection method.* The subcutaneous method is the one that has been in common use in this country for several years and consists in injecting the vaccine beneath the skin with a hypodermic syringe. The feather-follicle-infection method consists in applying vaccine to four or five feather-follicles on the leg from which the feathers have been plucked. The method was developed in Holland by deBlieck and van Heelsbergen,[1,2,3,4] and has been used on a large scale in that and some other European countries. In this country it has been used to a much more limited extent, but sufficiently, particularly on the Pacific Coast, to demonstrate its practical possibilities.

Experimental work at the California Experiment Station with the new or "live virus" vaccine was started in 1924. By 1926,

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sufficient progress had been made to warrant trial of the vaccine in the field and during that year approximately 11,000 pullets and cockerels on poultry farms were vaccinated by the subcutaneous method of vaccination. The results,[5] both as regards immediate effect of vaccination on the birds and protection against chicken-pox, were so satisfactory that, during 1927, vaccine was furnished for approximately 100,000 birds on about fifty selected farms. The results, as a whole, of this extensive field use of the vaccine were likewise satisfactory. During 1928, preventive vaccination of young stock was practiced on a still larger scale. Although no exact figures are available, it is certain that the number of pullets and cockerels in the State that were vaccinated during the summer and fall of that year is considerably in excess of one million.

In the application of a live-virus chicken-pox vaccine, consideration must be given to two factors: first, the ability of the product to immunize, and, second, the effect of the administration of the product on the health of the birds and the liability of its inducing harmful chicken-pox infection among them. This paper is concerned only with the immediate effects of vaccination on the healthy young birds. It should be stated, however, that abundant evidence has been obtained to show that the vaccination of fowls with live-virus chicken-pox vaccine is a highly efficient means of immunizing them against the disease.

To secure information regarding the immediate effects of vaccination on the fowls, a questionnaire was sent to all poultrymen for whom vaccine was supplied by the Division of Veterinary Science, University of California, during 1928, in from sixty to ninety days after the vaccine had been used. In this questionnaire, information was requested regarding the number, age, sex and condition of the fowls vaccinated, and the condition of health, occurrence of chicken-pox, and egg-production during the sixty-to-ninety-day period following vaccination. This was supplemented by personal observations in many instances. By these means, data were secured concerning the effects of the vaccination of 381 flocks, comprising 312,735 birds.

The vaccine was prepared from fresh chicken-pox lesion tissue immediately after removal from artificially infected cockerels in accordance with the method described by the writer in 1927.[5] The concentrated vaccine which contained 0.25 gram of lesion tissue or virus per cubic centimeter was diluted, at the time of use, sufficiently to make each cubic centimeter contain .002 gram of

tissue. The same dilution was used for vaccination by both the subcutaneous and feather-follicle methods.

Effects of Vaccination by the Subcutaneous Method

Information concerning 350 flocks, consisting of 250,305 birds, that were vaccinated by the subcutaneous method was obtained. The dose of vaccine was uniformly 1 cc for each bird. In summarizing the data, the birds have been divided into four classes as follows:

Class 1—Non-laying females.
Class 2—Laying females with production less than 10 per cent.
Class 3—Laying females with production 10 per cent or greater.
Class 4—Males.

Each class is further subdivided into "A" and "B" according to whether the results were reported as satisfactory or unsatisfactory.

Class 1—Non-Laying Females

In this class are included 244 flocks and 137,189 birds. The size of the flocks thus averaged approximately 600 birds but actually varied from 55 to 3,700. Approximately 60 per cent of the birds were from four to four and one-half months old, about 20 per cent were five months old, about 10 per cent were three and one-half months or less, and the remaining 10 per cent six months old at the time of vaccination. One flock of 480 birds was vaccinated at the age of two months with no undesirable effects being produced.

Class 1A—Satisfactory results: In 197 cases the results were considered by the poultrymen as satisfactory. In answer to the question, "What effect did vaccination have on the general health?" 58 (30.3 per cent) replied, "None;" 42 (22 per cent) stated that the birds appeared slightly droopy and consumed a little less food for a few days; 81 (42.4 per cent) said that there was a very noticeable decrease in appetite and droopiness during all or nearly all of the third and fourth weeks after vaccination, after which the fowls quickly returned to normal; and 11 (5.7 per cent) stated that a month or six weeks elapsed before the flock was entirely free from inappetence and droopiness.

Most of the poultrymen reporting believed that the start of egg-production was retarded for a period of from two to six weeks by the reaction from vaccination. Many expressed the opinion that as a result of the delay, egg-production rapidly increased after it did start, that there were less than the usual number of

small eggs and, therefore, that the retarding of the production of pullets could be considered as a desirable sequela or effect of vaccination. Actual production records were not given in a majority of cases but those that were given showed a variation in the production of the different flocks of from 5 to 55 per cent when the birds were from six to seven months old.

The figures gave the total mortality *from all causes* to be in most instances either none at all or about one per cent of the fowls vaccinated. In nine cases a higher mortality was reported. In three of these in which the mortality was given as 2 per cent, 5 per cent and 6.6 per cent respectively, chronic coccidiosis was the cause of the deaths. In two other cases mortality of 16 per cent of a flock of 300 and of 10 per cent of a flock of 500 was reported. Both of these flocks were said to have been heavily infected with roundworms and in poor condition when vaccinated. Other flocks of pullets on the farms that were free from parasites were vaccinated at the same time without any undesirable after-effects. In two cases in which a mortality of 3 per cent and 5 per cent respectively was reported, the losses were said to be confined entirely to birds that were small and thin when vaccinated and that probably would not have survived anyway. One poultryman reported that infectious bronchitis occurred in his flock a short time after vaccination and caused a heavy mortality. One reported a mortality of 6 per cent but expressed no opinion regarding the cause. He stated, however, that "the flock is now just fine and increasing in production every day."

The occurrence of chicken-pox lesions about the head of birds as a result of vaccination proved of little consequence. A large majority of the reports stated that either no, or a very few, birds were so affected. In a few cases head lesions were reported to have developed on from 5 to 10 per cent of the fowls vaccinated and in one case on half of a flock of 230 birds. In all instances the lesions were of slight extent and did not prove harmful.

Class 1B—Unsatisfactory results: In this classification are twenty-seven of the flocks, consisting of 18,985 of the birds. The results in eight of these flocks can not correctly be ascribed to the effects of vaccination because of other conditions present. These are as follows:

Flock 1: Nine hundred pullets, four months old. Both colds and roundworms were prevalent in this flock when it was vaccinated. After vaccination the condition of the flock became worse and approximately 250 birds died. Laboratory examina-

tion revealed infection with the fowl cholera organism, besides cold, roup, and intestinal parasites. The same combination of troubles had caused severe losses on this farm during the year previous to the time this lot of pullets was vaccinated, and has occurred in another lot of pullets raised subsequently and not vaccinated. It is improbable, therefore, that the vaccination of this flock was an important cause of the ensuing losses.

Flock 2: This was a lot of 154 pullets that were shipped to Hawaii and vaccinated immediately upon arrival. These birds suffered from decreased appetite and consequent loss in flesh and did not regain normal condition for over three months. The mortality was small. The effect of the long journey was probably a factor in bringing about the trouble in this flock.

Flock 3: This is a lot of 600 pullets among which infectious bronchitis occurred about three weeks after vaccination and caused quite severe loss. There is no reason to believe that there is any connection between vaccination and the occurrence of infectious bronchitis.

Flock 4: This lot of 3,600 birds, varying in age from two to five months, were quite heavily infested with roundworms when they were vaccinated and were given nicotin capsules at that time. These birds exhibited very little effect from vaccination but failed to develop properly and cold became prevalent among them. Examination of some of the birds a month later showed massive tapeworm infestation. It is obvious that the intestinal parasites were the principal cause of trouble in this case.

Flock 5: This flock of 600 pullets was not fully recovered from an attack of coccidiosis and was badly infested with lice when it was vaccinated. These birds made very little development for about two months after vaccination. The mortality was low.

Flocks 6, 7 and 8: These flocks consisted of 600, 395, and 75 birds, respectively. All were in poor condition when vaccinated. The owner of flock 6 states that the birds have always been unthrifty and were considered hardly worth raising. Vaccination seemed to have little general effect on the birds but colds and roup became prevalent and 200 birds died. The owner of flock 7 gives no information except that he considers the results satisfactory considering the condition of the birds at the time of vaccination. Flock 8 was in poor general condition and ten per cent of the birds had chicken-pox when vaccinated. The birds were said to have made very little development after vaccination. It is very probable that the condition of these birds at the time of

vaccination was such that development would have been slow and losses heavy regardless of whether or not they had been vaccinated.

In the reports concerning nine other flocks, consisting of 5,125 birds, the only dissatisfaction expressed was that the birds were slow in starting to lay. The effect on the general health of the birds was not said to be unusually severe nor was the mortality high. As previously stated, many poultrymen considered retarding of egg-production as a desirable effect of the vaccination of pullets. There would seem to be some question, therefore, as to whether the results of vaccination in these nine flocks should be classified as unsatisfactory.

Of the twenty-seven flocks in the "unsatisfactory results" class, there are remaining, therefore, ten flocks containing 7,313 birds. These ten flocks were all in good condition at the time of vaccination. In all cases the usual reaction, that is, decrease of appetite and consequent loss of weight and retarded production were severe and prolonged. In six of the flocks the mortality was not great but the loss from the culling out of birds which failed to recover in some cases amounted to 25 per cent of the birds. In the four remaining flocks the loss from mortality and culling was very heavy. Our flock of 1,100 birds was in this way reduced to half that number. From another flock of 480 birds, 300 were sold as worthless for egg-production and the remainder were considered of questionable value. The third flock of 1,650 birds lost 20 per cent by death and many more by culling. The egg-production of the remainder was only about 25 per cent when the birds were over eight months old. In the fourth flock the loss from death and culling was nearly one-third of the 760 birds vaccinated. There is at present no explanation of the serious trouble in these ten flocks other than that it was due to the effects of vaccination. However, this can not be the real explanation since many other flocks received vaccine from the same lot as was given to these ten flocks and were not harmed in any way. It would appear, therefore, that an at present unknown and unrecognizable condition of the flocks at the time of vaccination was the factor responsible for the severe post-vaccination reaction. It is of interest to note that the owner of the flock most severely affected did not feel that the vaccine was at fault because of the fact that several other flocks in his neighborhood, that were vaccinated at about the same time as his, showed no ill effects. The unfavorable results in these ten flocks are of importance as

indicating what effect vaccination may have on a flock but not that vaccination of pullets is a hazardous undertaking, since they constitute but 4.4 per cent of the 224 flocks and 5.3 per cent of the 137,189 non-laying pullets vaccinated.

Class 2—Laying Pullets with Production Less Than 10 Per Cent

In this class there are 57 flocks, containing 32,387 birds. The size of the flocks averaged 568 birds but the actual variation was from 35 to 1,600 birds. One flock was six and one-half months, one was seven months, and one was two years old. The remainder were about equally distributed between the ages of four and one-half, five, and six months. Egg-production at the time of vaccination varied from less than one to nine per cent.

Class 2A—Satisfactory results: In the reports concerning 47 of the flocks, consisting of 26,697 of the birds, the results were considered satisfactory by the poultrymen.

Fourteen reported that vaccination had no effect on the general health or behavior of the birds; eight, that there was very little noticeable effect; twenty, that there was a distinct decrease in appetite and that many of the birds were droopy during the third and fourth weeks; and three, that the inappetence and droopiness persisted for about a month and that a few birds were permanently stunted. None stated that there was any mortality directedly attributable to vaccination. However, in two flocks losses occurred from chronic coccidiosis; in four, from infectious bronchitis; and in one, from rupture (injury to the vent or eversion of the oviduct caused by the passage of an egg). Losses from such causes cannot be considered as related to the effects of vaccination.

In most instances none of the fowls developed chicken-pox lesions on the head following vaccination. In some flocks, however, a few fowls were so affected and in two flocks head lesions occurred on twenty and fifty per cent, respectively, of the birds All cases were mild and in no way harmful.

Many poultrymen expressed the opinion that the egg-production was retarded for from two to four weeks by vaccination. The production figures that were given, however, show an increase in average production of the flocks of from about 4 per cent, at the time of vaccination, to about 33 per cent, sixty days later, which would appear to be fairly satisfactory. In some of the

reports it was mentioned that egg-production later continued to increase satisfactorily.

Class 2B—Unsatisfactory results: The owners of ten flocks expressed dissatisfaction at the results of vaccination. In the case of five of these, it is doubtful if the conditions that prevailed were really due to vaccination. In one case, chronic coccidiosis caused the death of 26 and sickness of 120 others, out of a flock of 1,000. This trouble was not detected until the fifth week after vaccination and the fowls had exhibited very little of the usual symptoms of a vaccination reaction. In the other case, the fowls did not exhibit any marked evidence of reaction from vaccination, but colds became prevalent. In the three other flocks, egg-production was slow in starting, although the reaction from vaccination had been slight. It is not at all certain, therefore, that vaccination was responsible for the tardiness in production. In the remaining five flocks, the reaction was severe and recovery slow. There was very little mortality in one of these flocks but the inappetence and droopiness of the birds was not entirely corrected for over two months. Colds became prevalent in the meantime. In another flock many of the birds failed to regain normal condition and were culled. The actual mortality was small. The three other flocks suffered a mortality of 10 per cent or more, besides a heavy loss from the culling of poor birds. The seriousness of the trouble in one flock was aggravated by the occurrence of infectious bronchitis. These five flocks, in which the developments after vaccination caused rather severe loss and which were apparently due to the effects of vaccination, represent 8.6 per cent of the fifty-seven flocks and 9 per cent of the 32,387 laying pullets, with production less than 10 per cent that were vaccinated.

Class 3—Laying Females with Production 10 Per Cent or Greater

In this class are 82 flocks containing 75,388 birds. The size of these flocks averaged 920 birds, but the variation in size was from 20 to 10,000 birds. The ages of the birds are as follows: 22 flocks, five months; 34 flocks, six months; 12 flocks, seven months; 1 flock, eight months, and 13 flocks, one to two years.

Class 3A—Satisfactory results: The reports of 69 of the flocks in class 3, containing 62,126 of the birds, stated that the results were satisfactory. Fifty-six of these flocks consisted of pullets and thirteen of hens. The effects of vaccination of the

pullet flocks were reported to be as follows: no visible effects in 16 flocks; very little effect in 13 flocks; the usual inappetence and droopiness for from one to two weeks in 25 flocks; and inappetence and droopiness lasting for nearly a month in three flocks. With three exceptions losses from all causes following vaccination were negligible. The three exceptions mentioned were a 6 per cent mortality in one case and a 10 per cent mortality in another, all apparently from the effects of vaccination, and a mortality of 10 per cent from "rupture" in the third. In this latter case two flocks of 900 pullets on the farm came from different sources but were of the same age and were vaccinated at the same time. The losses were entirely from one flock. This flock also had a much more severe post-vaccination reaction than the other. These results support the idea that some, as yet unknown and undetectable, condition or quality of the stock rather than the vaccine itself is responsible for the occasional occurrence of severe reactions following the vaccination in flocks that are apparently in excellent condition when vaccinated.

A few fowls in some flocks (20 per cent in one) developed mild chicken-pox lesions on the head after vaccination.

The effect of vaccination on the egg-production of the pullets is shown by the following figures: average production, thirty days before vaccination, 16.5 per cent; at the time of vaccination, 26.8 per cent; thirty days after vaccination, 20.2 per cent; sixty days after vaccination, 35 per cent. This shows a downward trend in the production during the first thirty days after vaccination, after which there was a fairly rapid increase. However, the production in some flocks increased steadily from the time of vaccination. In some others production decreased markedly and sixty days later had not yet returned to the rate at the time of vaccination. Such production performance, however, was confined almost entirely to *16 flocks that molted after vaccination.*

As stated above, 13 of the flocks in class 3 were from one to two years old. The total number of such birds was 9,659. Five of these flocks were molting at the time of vaccination and production was therefore at a low point. Production increased in a normal manner after the completion of the molt. In five flocks egg-production was beginning to decline but the molt had not yet begun. These fowls molted soon after vaccination and egg-production declined accordingly. The production of two flocks was reported to have been 50 per cent at the time of vaccination and to have continued at that rate during the following two

months (August and September). The report concerning the one remaining flock gave no production record. All reports stated that vaccination had little or no effect on the general health of the birds. Although the number of flocks and birds involved is too small to justify definite conclusions being drawn, the results at least suggest that the vaccination of hens during the summer or fall just preceding, or at the time of the molt, is a safe procedure.

Class 3B—Unsatisfactory results: The reports from 13 flocks, consisting of 13,262 birds, stated that the results were not satisfactory.

The cause of the dissatisfaction in four of these flocks could hardly be considered as related to vaccination. In one of them there was a loss of approximately 700 birds out of 2,600 from fowl cholera and roup. Much trouble from fowl cholera, fowl typhoid and roup had been experienced on this farm during several months immediately preceding the time of vaccination. In two other flocks, containing 3,740 birds, infectious bronchitis occurred. Concerning the fourth flock of 500 birds, it was said that "layers tended to blow-outs." Egg-production in this case had steadily increased from 10 per cent to 40 per cent during the sixty days after vaccination.

In the case of two other flocks the only complaint was that the fowls molted and egg-production was affected accordingly. The production in one of these flocks, three months after vaccination (November) however, was reported to be 55 per cent. No production record for the other flock was given. It would seem that molting of a flock of pullets that are well advanced in production should be expected to occur quite commonly when such birds are vaccinated or subjected to any other unusual treatment and therefore that it should be regarded as an expected sequela of vaccination.

The remaining seven flocks of class 3B, consisting of 4,404 birds, suffered from severe post-vaccination reactions from which recovery was slow. In six of these from 10 to 25 per cent of the birds died and many more were culled because of their failure to regain normal health. The seventh flock suffered very little from death of birds, but the inappetence and droopiness of the birds remained for fully two months and was responsible for many of them becoming unsuitable to keep for egg-production. There was no apparent explanation for the trouble in these flocks other than that it was due to the effects of vaccination. These seven

flocks constitute 10.1 per cent of the 69 flocks (the 13 flocks of hens not included) and 7.0 per cent of the 65,729 pullets, with production greater than 10 per cent that were vaccinated. Such results make it appear that the vaccination of pullets that are well advanced in production is attended with greater liability of severe post-vaccination reactions than is the vaccination of younger pullets.

Class 4—Males

Reports were received concerning the vaccination of only 5,341 cockerels in 35 flocks. It is certain, however, that many more than this number of males were vaccinated. The size of the flocks varied from 6 to 1,300; the age from three to six months.

Class 4A—Satisfactory results: The owners of 30 of the flocks reported satisfaction with the results. Vaccination was said to have had little or no effect on the general health of the birds in 20 flocks; to have caused inappetence and droopiness of the birds for from one to two weeks in nine flocks, and for more than a month in one flock. In this latter case the birds were said to have been in poor condition and infested with intestinal worms when they were vaccinated. Ten birds in one flock developed mild chicken-pox lesions on the head.

Class 4B—Unsatisfactory results: In five reports dissatisfaction with the results were expressed. In one case the cause of dissatisfaction was the occurrence of about 75 mild cases of chicken-pox among 1,300 birds during the second month after vaccination. This was undoubtedly due to failure of vaccination to immunize all of the birds completely. The general health of this flock was good at all times. In another case the birds remained healthy for a month after vaccination. During the second month, the condition became very poor and 100 of the 500 birds died. The cause of the serious trouble in this flock is unknown, but it seems unlikely that it was due to the effects of vaccination, since it did not appear until more than a month after vaccination.

In the three other flocks, consisting of 150 birds, inappetence and droopiness appeared in about two weeks after vaccination and continued for more than a month. The loss from death and failure of birds to regain normal health was considerable. These unfavorable results appeared to be due entirely to the effects of vaccination. These three flocks constitute 8.5 per cent of the 35 flocks and 2.8 per cent of the 5,341 males vaccinated.

Effects of Vaccination by the Feather Follicle Infection Method

Vaccination by this method has consisted, for the most part, of applying the vaccine with an ordinary, small, stiff-bristled mucilage-brush, to an area of the skin of the leg containing from four to six feather follicles from which the feathers have been plucked. This procedure was adopted after numerous trials in which various types of applicators, including camel's-hair brushes and cotton swabs, were used and in which vaccine was applied to the exposed follicles only, and to the entire skin area containing the follicles. The application of vaccine with the stiff-bristled brush to the skin area containing the follicles is a simpler procedure than application to each follicle separately and just as certainly produced a lesion or "take" in the exposed follicles and there only. This procedure might be considered as wasteful of vaccine, but the amount required in either case is so small that this cannot be regarded as an important consideration.

In the application of the feather-follicle-infection method, entire flocks were vaccinated by this method in some instances, while in others approximately half of the birds were vaccinated by this method and the remainder by the subcutaneous method. This made it possible to make a direct comparison of the effects of vaccination by the two methods in birds of like quality and age kept under identical conditions.

The comparisons of the two methods of vaccination were made with twenty flocks, containing 15,154 birds, 7,099 of which were vaccinated by the subcutaneous method and 8,065 by the follicle-infection method. Chicken-pox lesions or "takes" at the point of vaccination occurred on more than 90 per cent of the fowls. In seventeen of the twenty flocks, which comprised 11,116 of the birds, there were no undesirable after-effects, of vaccination by either method. The slight reactions, mortality, and chicken-pox lesions that did occur were no different than already described in the discussion of vaccination by the subcutaneous method. With the exception of two flocks, the age of the birds was from three and one-half to four and one-half months. The two exceptions were one flock of 305 eight-months-old and one of 694 eighteen-months-old birds. These were vaccinated on July 17. Both flocks molted and therefore decreased in egg-production but were not otherwise affected.

In the case of three flocks, consisting of 4,038 birds, the occurrences following vaccination were highly undesirable. A description of these flocks follows:

Flock 1: The flock consisted of 740 four-months-old pullets. Three hundred and sixty-five were vaccinated by the follicle-infection method and 375 by the subcutaneous method. A majority of the birds had "colds" but were apparently in good condition otherwise. Laboratory tests showed that the vaccine used in the follicle-infection method was *dead** and therefore that the birds on which it was used were really not vaccinated. The vaccine used in the subcutaneous method, however, was, potent. The farm was again visited three weeks later, for the purpose of revaccinating the follicle-infection-method group that had received the dead vaccine. At this time it was found that in *both* groups the birds had lost appetite, were droopy, that colds and roup had become more prevalent, and that many were thin. Autopsy of some of the thin birds showed roundworms to be plentiful in the intestines. Treatment for these parasites was advised but was not carried out until more than a month later. In the meantime the condition of the flocks did not improve and many died. Bacteriological examination showed some of the dead to be infected with the fowl cholera organism. After about three months, those that survived were again normal. The total mortality was approximately half of each group. It is to be noted especially that the health of both groups of birds declined to a marked degree during the first three weeks after vaccination. However, since the vaccine used in follicle-infection vaccination was *dead,* this group of birds had in reality not been vaccinated and, therefore, their decline in health could not be attributed to that cause. Furthermore, both groups were infected with intestinal roundworms. These facts would seem to indicate that the losses in this flock would have occurred whether or not vaccination had been practiced.

Flock 2: This was a younger flock of birds on the same farm as flock 1. It consisted of three lots. Lot 1 contained 773 six-months-old White Leghorns; lot 2, 483 White Leghorns four and one-half months old; and lot 3, 482 Barred Rocks four to four and one-half months old. Each lot will be discussed separately.

Lot 1: This consisted of two pens of 258 and 250 first-grade birds respectively and one pen of 165 second-grade birds. Egg-

*The death of the virus in this lot of vaccine resulted from the handbag containing it being carelessly left exposed to the hot sun rays for about two hours while the vaccination of the 375 birds by the subcutaneous method was being done.

production of the first-grade birds was 30 per cent. The second-grade birds had not started laying. The pen of 258 first-grade birds was vaccinated by the subcutaneous method; the others by the follicle-infection method. During the third week, droopiness and decrease in appetite was observed in all pens. This condition lasted for about ten days only. Colds and infectious bronchitis also appeared in all pens during the third week and continued for more than a month. The mortality was as follows: 13.5 per cent of the first-grade birds vaccinated by the subcutaneous method and 16.4 per cent of the first-grade birds and 13.3 per cent of the second-grade birds vaccinated by the follicle-infection method. The greater part of the deaths were among birds exhibiting symptoms of infectious bronchitis and roup. The lining of the esophagus of a few of those that died was covered with a tough, yellow, fungus-like growth. The cause of this was not determined. The condition of the flock and egg-production was again normal, two and one-half months after vaccination. None of those vaccinated by the subcutaneous method developed chicken-pox lesions on the head. There were thirty birds with slight head lesions from vaccination by the follicle-infection method.

Lot 2: These pullets were ungraded and somewhat undersized. Two hundred and five birds, in a colony-house adjacent to those occupied by lot 1, were vaccinated by the subcutaneous method. Two hundred and seventy-eight birds, in a house some distance away, were vaccinated by the follicle-infection method. Both groups of birds were droopy and consumed less food during only the third week after vaccination. The flock vaccinated by the subcutaneous method became affected with colds and infectious bronchitis to about the same extent as lot 1. The mortality was 16 per cent and was almost entirely among birds with roup or infectious bronchitis. In the flock vaccinated by the follicle-infection method there were very few birds with colds and none with infectious bronchitis. There was a mortality of 8.2 per cent, all among birds that became extremely emaciated from massive tapeworm infestation. There was no further trouble of this nature after the administration of treatment to remove these parasites.

Lot 3: The 482 Barred Rocks were in three small colony-houses. House 1 contained 193 birds in fair condition. House 2 contained 141 birds, many of which were undersized and in poor flesh. The mortality in this house had been excessive. These

two houses were adjacent to those occupied by the birds of lot 1. House 3 was some distance removed from the others and contained 148 birds. The follicle-infection method of vaccination was used in houses 1 and 2; the subcutaneous method in house 3. All three flocks were droopy and had little appetite during the third week after vaccination. Colds and infectious bronchitis became prevalent in houses 1 and 2. The mortality in these two houses was 20 per cent, and was confined almost entirely to birds with roup or infectious bronchitis or that were in poor condition when vaccinated. In house 3 there was little roup and no bronchitis. The entire mortality consisted of two birds that were emaciated.

It is shown, in the preceding discussion of flock 3: First, that in no case was the usual post-vaccination reaction unusually severe or prolonged; second, that colds and roup became prevalent in six of the eight lots of birds vaccinated and that the loss among these birds was severe; third, that the two remaining lots of birds, both of which were in houses somewhat removed from the others and one of which was vaccinated by the subcutaneous method and the other by the follicle-infection method, remained relatively free from colds and roup and entirely free from infectious bronchitis, and that, with the exception of two birds, the only losses occurring in these two lots were definitely the result of massive tapeworm infestation. It would seem, therefore, that the trouble in the flock was not entirely the result of vaccination and that much of it might have occurred whether or not vaccination had been practiced.

Flock 3: This flock consisted of 1,576 pullets between six and seven months old. Eight hundred and sixty were vaccinated by the follicle-infection method and 716 by the subcutaneous method. The birds of both lots became droopy and lost appetite and weight during the third week after vaccination. The flock did not return to normal condition until over two months later. During this time, infectious bronchitis appeared and caused the death of thirty-seven birds. The loss, exclusive of that from infectious bronchitis, was approximately 11 per cent of the birds of both groups, and would undoubtedly have been much greater had not the owner constantly removed the sickest birds from the flock and given them especial care. Egg-production declined from 16 per cent at the time of vaccination to less than one per cent in three weeks and did not return to the prevaccination rate until about two months later. It increased satisfactorily afterwards.

There appeared to be no explanation of the trouble in this flock other than that it resulted from the effects of vaccination.

As previously stated, in a number of flocks, the follicle infection method was used for vaccination of all of the birds. Records of the effects of vaccination were obtained from flocks containing 48,325 birds. In eleven of the flocks, consisting of 44,776 of the birds (39,684 pullets and 5092 cockerels), the results were entirely satisfactory. The age of the birds varied from three to five months. Most of these flocks exhibited some depression and inappetence during the third and fourth weeks after vaccination, from which prompt recovery was made. There were no deaths that could be attributed to the effects of vaccination. Twenty per cent of 1,413 birds in one flock developed mild chicken-pox lesions about the head during the second and third weeks after vaccination. In all cases, these lesions healed in a few days without harming the birds. In the other eleven flocks, the number of birds on which head lesions were produced by vaccination was negligible.

In three flocks, consisting of 3,549 birds, the occurrences following vaccination were less satisfactory:

Flock 1: This consisted of 2,550 fowls from 6 months to 1½ years old. Previous to and at the time of vaccination, birds were dying in this flock at the rate of eight to ten each week. These losses were of a non-specific nature, such as are usually ascribed to faulty methods of feeding and management. Droopiness and inappetence became prominent during the third and fourth weeks and losses increased. A total of 211 birds (8.2 per cent) died during the sixty-day period after vaccination. By the end of this period, the flock was entirely normal in appearance. It would seem that in this case the reaction from vaccination accentuated the abnormally large losses that were already occurring at the time of vaccination, but was not entirely responsible for the mortality following vaccination.

Flock 2: This flock was on the same farm as two of the flocks in which serious losses occurred following vaccination of part of the birds by the subcutaneous and part by the follicle-infection method. It consisted of 875 birds between 3½ and 4 months old. They were in fairly good condition, but uneven in size, and in a house that was much too small for that number of birds. All birds developed a vaccination take involving from four to ten follicles. Slight chicken-pox lesions developed on the head of 5.8 per cent. The birds became droopy and their appetite decreased

during the third week after vaccination and many rapidly lost weight. All of the birds developed colds and many exhibited symptoms of infectious bronchitis. During four months following vaccination, 37 per cent of the birds died, most of them after becoming emaciated but many while still in good flesh. Post-mortem and bacteriological examination showed the presence of a variety of conditions, which included infectious bronchitis, infection with the fowl cholera organism, infestation with round- and tapeworms, and evidence of vitamin-A deficiency. In explanation of this last-mentioned condition, it should be stated that vitamin A was supplied solely by alfalfa meal, yellow corn meal, and cod-liver oil in the mash. A deficiency of this vitamin could easily result, therefore, when appetite failed and little mash was consumed. The initial depression and loss of appetite of this flock was probably due to the post-vaccination reaction. It seems reasonable to assume, however, that the prolongation of sickness and heavy losses was due principally to the other factors mentioned above.

Flock 3: This flock consisted of 124 rather thin, second-grade pullets, seven months old; 175 pullets, three and one-half months old; and 108 pullets, four and one-half months old. Both of the younger flocks were in good condition. In this case vaccine was applied to from 20 to 30 follicles and pronounced takes involving that number of follicles were obtained. The seven-months-old birds were very severely affected. All suffered a marked loss of weight, 86.6 per cent had chicken-pox lesions on the head, ranging from mild to severe, 39.5 per cent died during the first month, and many more were rendered permanently worthless. The two other lots experienced a rather severe reaction, from which they recovered promptly, with a loss from death of only 5 birds. Slight and harmless chicken-pox lesions developed on the head of 8.2 per cent of one lot and 9.2 per cent of the other. The large number of follicles infected at vaccination was probably an important factor in causing the severe reaction in the flock. The quality, condition and age were probably the factors responsible for the very severe reaction and losses among the seven-months-old birds, since the younger birds that were in good condition experienced a much less severe reaction and no more than normal loss.

From the discussion of these three flocks, it is seen that, in the first flock, the mortality was abnormally high before vaccination; that, in the second flock, the housing conditions were unsatis-

factory, numerous types of disease were observed in the birds, and that other flocks on the same farm experienced trouble after vaccination, which strongly suggests low vitality of stock or faulty management; and that, in the third flock, poor quality of stock and too extensive vaccination infection were largely responsible for the occurrences following vaccination. It would seem, therefore, that the effects of vaccination cannot be regarded as the major cause of the post-vaccination losses.

The results, as a whole, of the field trials of vaccination with live-virus vaccine by the follicle infection method, both alone and in comparison with the subcutaneous method, indicate that the immediate effect of vaccination on the birds can be expected to be about the same regardless of the method employed.

Discussion

In the foregoing report of the results of vaccination of healthy young fowls with live-virus chicken-pox vaccine, specific mention of flocks has been made only in case the results were unsatisfactory. This has been done so that prominence might be given to the fact that very undesirable post-vaccination reactions have sometimes occurred, even when the condition of the birds and of the surroundings appeared to be entirely satisfactory. The data show, however, that, with birds in good condition, the undesirable results are not liable to occur frequently and, therefore, that the vaccination of healthy cockerels and non-laying pullets or hens may be regarded as a relatively safe procedure. The hazard attending the vaccination of laying pullets, although apparently greater than of non-laying birds, does not seem to be great enough to make this a practice to be avoided entirely in case the flock without vaccination is quite certain to become infected with chicken-pox later.

In seeking possible explanations of the serious losses following vaccination of some flocks, consideration might be given to the fact that outbreaks of colds and roup are of common occurrence among flocks of young birds and also that, in some flocks of apparently healthy pullets and cockerels, there occur rapid loss of condition and death of many birds for which no definite explanation is found. It is possible, therefore, that at least a part of the trouble that was experienced following vaccination of some of the flocks would have occurred if vaccination had not been practiced. Definite knowledge concerning this point can be obtained only by vaccinating a part of a number of flocks and leaving the other

portion unvaccinated for from four to six weeks. It is hoped that such controlled field trials may be carried out in the near future.

The method of vaccination employed does not appear to be a factor in either increasing or decreasing the liability of the occurrence of undesirable post-vaccination reactions. The follicle-infection method, however, because of its simplicity, the small amount of vaccine required, and the ease and certainty with which a "take" can be recognized will probably be generally regarded as more desirable than the subcutaneous method.

It would seem that sufficient information regarding the effects and results of preventive vaccination against chicken-pox has now been obtained to warrant the adoption of this practice on poultry farms on which chicken-pox has been prevalent and on which the management and general health of the fowls are satisfactory. Veterinarians or others supplying or administering vaccine, however, should keep in mind that it is advisable that young fowls be vaccinated before egg-production has started; that fowls which are suffering from other diseases or that are in a poor state of nutrition, because of faulty management or diet, intestinal parasites or other causes, should not be vaccinated until they have regained normal health and the conditions that were responsible for the trouble have been corrected; that fowls are liable to become droopy and consume less food during the third and fourth weeks after vaccination; that in an occasional flock, such a reaction may be severe and prolonged and be responsible for the death of a number of birds, and that poultrymen should be informed of these possibilities before the vaccine is administered; and that it is necessary to vaccinate all of the susceptible fowls on a farm within a period of from one to two months to avoid transmission of chicken-pox to the susceptible fowls from those which have been vaccinated with the live-virus vaccine.

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FUMIGATION OF FORCED-DRAFT INCUBATORS*†

By L. D. BUSHNELL, L. P. PAYNE *and* C. J. COON‡

Kansas Agricultural Experiment Station

Manhattan, Kansas

INTRODUCTION

In 1926, while working at the Kansas Agricultural Experiment Station, Hinshaw, Upp and Moore[1] found that it was possible for the organism of bacillary white diarrhea to pass from one end to the other of a forced-draft incubator and infect chicks to the extent that they died of the disease. This work was done with artificially contaminated material. In 1927, Hinshaw, Scott and Payne[2] confirmed these results by the use of eggs and chicks from hens found to be carriers of the disease.

These findings led at once to an attempt to control this infection by artificial means. Gwatkin[3] reported on a series of experiments in which he was able to fumigate an incubator successfully six and eight times, respectively, during hatches without apparent injury to the hatchability of the eggs. He found that 2 cc of formalin and 0.666 gm. potassium permanganate crystals per each cubic foot of space were necessary to kill *Salmonella pullorum.* In addition, he found it necessary to seal tightly the still-air type of incubator and leave it closed for one hour.

Coon[4] found that 0.25 cc formalin and 0.125 gm. potassium permanganate ($KMnO_4$) per each cubic foot capacity of a forced-draft incubator killed *S. pullorum* cultures in one hour. He did not find it necessary to seal the door or the intake and exhaust ports.

With the above points in mind an exhaustive study of methods of disinfecting incubators of the forced-draft type was undertaken. Due to lack of time and facilities, no experiments were undertaken with still-air incubators.

The peculiar nature of the problem has led to the consideration of many factors not usually met with in ordinary fumigation work. The fact that the hatches come out of the machines two or three times weekly, while the machines are continually filled

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with eggs which are also exposed to the fumes makes the use of a highly toxic and liquid product dangerous. As a complicating factor the chicks are hatching over a period of 24 hours or more and if the relative humidity is high, chicks dry slowly and scatter down into the air of the machine over a period of several hours. (However, see results of experiments on high humidity, at the end of the paper.)

We have found that chicks hatching from contaminated eggs are covered over the entire body with the bacillary white diarrhea organisms. These are thrown off into the air as the chick dries and the fluff expands. Herein lies the danger, since the organisms are thus carried to all parts of the machine. The exact manner in which normal chicks become infected is not known, but it is probably largely through inhalation of contaminated material. Since the air of the machines will be continually recontaminated by newly hatched chicks, a continuous fumigation is indicated by the facts of the case.

Experimental Methods

The points considered were: (1) type of disinfectant and its mode of application; (2) the organism used and the manner in which it should be exposed; (3) the electrical precipitation of the chick-down; (4) use of ultra-violet light to sterilize the chick-down in the incubator; and (5) influence of relative humidity on the circulation of chick-down.

The disinfectant: It was realized at the outset that to obtain successful results under practical conditions it would be necessary to employ a gaseous disinfectant, since the presence of eggs in the machine from the beginning to the end of the hatching season excluded the use of either a solid or a liquid disinfectant. Also, the very rapid exchange of air in the forced-draft machine makes it necessary to use rather large doses in order to kill the organism quickly. Of all the known gaseous disinfectants, formaldehyde seemed to be the most promising. It is quite highly toxic to lower plant forms and comparatively non-toxic to higher forms of animal life. It is easily applied in the form of a gas and the high temperature and relative high humidity of incubators greatly increase its toxicity. For these reasons the permanganate method was used in most of the fumigation experiments.

The dosage of formalin and potassium permanganate has been determined by numerous writers. McClintic[5] recommended about the proportion of 1 cc of the former to 0.5 gm. of the latter.

Rideal and Rideal[6] found 40 gm. of permanganate to 100 cc of formalin to be effective. Several writers quoted by them are of the opinion that 1 cc of formalin to 0.5 gm. of permanganate is best. Posen and Dieter[7] submitted a large number of chemical methods to an exhaustive bacteriological study and came to the conclusion that under the proper conditions of operation the formaldehyde-permanganate method was effective, and recommended the following quantities for sterilizing each 1,000 cubic feet of room space: formalin, 1 pint; potassium permanganate, 0.5 pound.

Coon[4] found a slight excess of permanganate over that recommended by McClintic to give a slightly more rapid and complete vaporization of the formalin unless the vessel containing the mixture was placed in a large volume of water, in which case the mixture was cooled so that complete vaporization of all formalin was not attained.

The question of the formation of paraformaldehyde is discussed later in this paper. The use of the hot plate for the vaporization of this substance is also discussed.

Exposing the organism: The organisms in the incubator were exposed by replacing the hatching-door with a strip of beaver board through which some three-fourth-inch holes had been bored. The holes were fitted with rubber stoppers carrying stiff wire loops about a foot in length. Wire screen was stretched across the stiff wires of the loops, thus forming small wire basket carriers in which the contaminated material could be exposed inside the machine. The tight-fitting stoppers prevented the escape of the fumigant and the wires held the contaminated material in such a position as to be exposed on all sides to the action of the gas. At the same time, sampling was easy without loss of large amounts of the disinfectant.

The cultures used were typical throughout for *Salmonella pullorum* and *Pasteurella avicida*. They were grown on standard meat-infusion agar for 24 hours, suspended in physiological salt solution and poured over small bits of sterile gauze, filter paper, egg-shells, or pads of chick-down wrapped in a single layer of gauze. All contaminated material was air-dried in an incubator before being used. At intervals during fumigation some of the contaminated material was removed from the machine and placed in tubes of nutrient broth. In order to avoid any antiseptic action on the samples by disinfectant which may have been transferred to the broth tubes, a small amount of the broth was

transferred to another tube. All tubes were incubated at 37° C. for several days. If no growth occurred, the sample was considered to be sterile. Control cultures always were made on unfumigated material to see that the organisms were still alive.

Experimental flocks: Eggs for this work were from two sources. A flock of 83 birds on the college farm which had been carefully tested for several years and from which no chicks had died of bacillary white diarrhea furnished the controls. All the birds of this flock reacted negative to the agglutination test and were considered to be entirely free of the disease. None of the eggs were examined and none of the chicks died of bacillary white diarrhea during the experiment unless exposed after hatching. The flock was blood-tested four times.

A flock of Rhode Island Reds, all of which reacted positive to the agglutination test in dilutions of 1-40 or above, were used for carriers. They were trap-nested for about one month. Practically all the unincubated eggs and all incubated eggs which did not hatch were examined bacteriologically for *S. pullorum*. This was done in order to find if the reactors were actually carriers of the organism.

Of the 58 birds here listed, which laid eggs during the period under investigation, 31 (53.4 per cent) laid one or more eggs from which the organism of bacillary white diarrhea was isolated. Of the 404 eggs examined bacteriologically, 60 (14.8 per cent) were found to be infected.

Livability of Chicks from Reactor Flock

Chicks hatched from the same lot of eggs which were examined were placed in "Liv-an-Gro" brooders and kept for fourteen days. Table I shows their livability.

It will be observed that 48.9 per cent of the chicks from the reactor flock died of bacillary white diarrhea by the fourteenth day after hatching. The dead chicks were autopsied and cultures were taken from the heart and liver. Only when a typical culture was isolated and tested was the chick considered to have died of the disease.

It was noted from an examination of our records that there was a great variation in the constancy with which hens lay infected eggs and with which infected eggs hatch into chicks which die of the disease. This is a factor which is entirely unknown and even unrecognized by most hatcherymen. This also explains why results with reactor flocks are so variable; some hatches giving

high hatchability and livability; while other hatches from the same birds give low hatchability and heavy chick mortality.

The examination was made by clipping some fluff from the breast and back of each of the chicks as they emerged from the shell and by taking a swab of the nasal cleft. This material was placed in culture media and examined later for *S. pullorum.*

The data showed that two of the 45 chicks were hatched from eggs which must have been infected with *S. pullorum.* The entire body was contaminated with *S. pullorum* and this organism was also isolated from the nasal cleft. Other observations show that the organisms will live for several hours when air-dried on chick-down. Also, that many organisms will be carried by the dry

TABLE I—*Livability of chicks from the reactor flock*

DATE OF INCUBATION (1929)	EGGS INCUBATED	EGGS HATCHED	CHICKS DEAD AFTER 7 DAYS	CHICKS DEAD AFTER 14 DAYS	*S. pullorum* ISOLATED	*S. pullorum* NOT ISOLATED	CHICKS INFECTED (%)
3- 9	96	51	7	30	28	2	54.9
3- 9	95	56	18	29	28	1	50.0
3- 9	90	45	7	15	15	0	33.3
3-15	96	60	8	35	35	0	58.3
3-15	75	40	9	32	28	4	70.0
3-15	75	35	7	20	15	5	42.8
3-22	96	48	4	22	22	0	45.9
3-22	96	43	6	25	23	2	53.5
3-22	96	45	2	14	11	3	24.4
3-29	95	52	5	23	22	1	42.3
3-29	96	42	9	27	23	4	54.7
3-29	96	54	9	27	25	2	46.5
4- 5	96	40	6	25	25	0	62.2
4- 5	96	44	9	26	20	6	45.4
Total	1294	655	106	350	320	30	Av. 48.9

particles of the dried material which is commonly, but incorrectly, called chick-down; "incorrectly" because practically none of it is actual "down" from the chick.

FUMIGATION EXPERIMENTS WITH S. PULLORUM

Formaldehyde was selected as a fumigant for our first experiments for reasons already stated.

Action of formaldehyde on S. pullorum and P. avicida with ports closed: Two No. 9 Buckeye and four 47,000-egg Smith Machines were used in determining the minimum lethal dose of formalin for the *S. pullorum* and *P. avicida* organisms in incubators. Each Buckeye incubator was in a separate room while the four Smith incubators were in one room. One of the Buckeye

machines was two years old and heated by means of a hot-water system. The other was new and electrically heated. All the cracks in the latter were sealed with putty, thus making it practically air tight except for the little air that might enter, or escape, around the doors and through the ports. This was the only Buckeye machine used in experiments dealing with formaldehyde fumigation. The results indicated that it was not necessary to pay particular attention to what few cracks there might be in the Smith machines.

In the experiments carried on by Gwatkin, in 1926, at the Ontario Veterinary College, it was found necessary to close and seal the door and ports of the incubator tightly for one hour. Guided partly by these experiments, the m.l.d. (minimum lethal dose), or minimum amount of formaldehyde necessary to kill *S. pullorum* and *P. avicida* with all ports closed, was first determined.

For this work small sterile cheese-cloth packages of chick-down were contaminated and exposed to varying amounts of formalin and for various periods of time on seventeen different occasions. Likewise, the relative humidity was varied.

In the first experiment formalin alone was used but since growth occurred after exposure for three hours, this method was discontinued and the formalin-permanganate method was used in all subsequent experiments in which the ports were kept closed.

Thirty-five cc of formalin liberated by 17½ gm. of potassium permanganate apparently gave the best results when the dry bulb reading was maintained at 100° F. and the wet bulb reading at approximately 90° F. When smaller amounts of formalin were used, inconsistent results were obtained. Thirty-five cc of formalin may therefore be taken to represent the m.l.d. for *S. pullorum* under the conditions of this experiment. The m.l.d. varies with different conditions. It especially is influenced by the humidity, temperature, and rate of diffusion of gas out of the machine.

It will be noticed that there was a close relation between the disinfecting value of formaldehyde and the amount of moisture in the incubator air. By increasing the relative humidity it was possible to kill the exposed organisms with a smaller amount of formaldehyde.

Action of formaldehyde on S. pullorum with ports open: It seemed desirable to determine the m.l.d. of formaldehyde with all the ports open, since it was not known just what effect the

closing of the ports for one hour would have on the normal operation of the incubator. It is reasonable to expect that the control of the temperature, relative humidity, and supply of fresh air would be somewhat influenced. The experiments were conducted as before except that the incubator was only partly filled with eggs.

Six experiments were conducted. In four cases the formaldehyde was liberated by adding formalin to potassium permanganate, and in two cases formaldehyde was allowed to evaporate from a pan containing formalin placed on the bottom of the machine.

When formaldehyde was liberated by adding formalin to potassium permanganate it was observed that practically the same results were obtained as when the incubator was fumigated with all ports closed. This is due to the fact that in most cases the exposed organisms were killed in a very short time, usually in less than ten minutes in either case.

According to McClintic's[7] work on formaldehyde fumigation carried on for the Public Health Service in 1906, the majority of the organisms were killed within the first five minutes. The formaldehyde is immediately liberated by the heat of the reaction between the formalin and the potassium permanganate, thus bringing the concentration in the incubator up to its maximum in less than five minutes. The forced-air draft immediately mixes the air in the incubator so that the concentration is very soon the same in all parts of the machine. As a result the formaldehyde exerts its maximum germicidal properties in a shorter time in a forced-air draft incubator than it would in a still-air room, such as McClintic used, where there is a diffusion of gases rather than a forced mixture of the rapidly circulating air.

Fumigation by the pan method: Two experiments in fumigating the incubator with ports open were tried by placing 2,000 cc of formalin in a pan 14 x 19 inches in one case, and 1,000 cc of formalin in a beaker 7¼ inches in diameter in another case. In the first experiment all the exposed organisms were killed in one, two and eighteen hours. In the latter experiment no growth occurred in tubes of sterile broth to which had been added the contaminated pledgets of cheese-cloth fumigated for ½, 1½ and 2¼ hours.

Due to the variable rate of evaporation brought about as a result of the increased vapor pressure and concentration of the formalin, there seemed to be no practical means of maintaining

a constant concentration of formalin, and therefore this method of introducing formaldehyde was abandoned.

Determination of the m.l.d. of formaldehyde in Smith incubators with all ports open: A Smith incubator owned by a commercial hatchery was used to determine the m.l.d. of formaldehyde for this type. *S. pullorum* was the only organism condsidered in these experiments.

The results indicate that 200 cc of formalin liberated by 115 gm. of potassium permanganate, when the wet bulb thermometer had a reading of 89 to 92° F., is not sufficient to secure consistent satisfactory sterilization. Three hundred and 400 cc of formalin liberated by 165 gm. and 220 gm. respectively of potassium permanganate with the dry-bulb reading at 99° F. and the wet-bulb reading at 90 to 91° F., did kill the *S. pullorum* on the exposed contaminated material in a sufficient number of cases so that either dose could be safely recommended for a machine of this size.

The Smith machine, with approximately eight times the cubic capacity of the No. 9 Buckeye, required approximately ten times as much formalin. The air of the Buckeye machine is completely displaced in about twenty minutes and in the Smith about every four minutes. The formaldehyde exerts most of its germicidal action in the first five minutes after liberation so that the results are about what would be expected under these conditions.

Formaldehyde Fumigation and the Hatchability of Incubated Eggs

Having determined the minimum amount of formaldehyde gas necessary to destroy *S. pullorum,* the next step was to determine its effect upon the hatchability of incubating eggs and hatching chicks. The results obtained on hatchability will be reported first.

It is reasonable to expect that tests with the ports closed are more severe than with the ports open and since the m.l.d. for formaldehyde was the same in each case the tests on the eggs were all conducted with the ports closed.

The eggs were from both the control and the reactor flocks and the experiments covered a period of approximately one month so that the seasonal factor did not play an important part.

Each setting of eggs was fumigated three times; the first usually on the first day of incubation with subsequent fumigations at weekly intervals. Thirty-five cc of formalin and 17½ gm.

of potassium permanganate were used in each case. The results of these experiments are shown in table II.

The data indicate that the hatchability of eggs fumigated three different times with formaldehyde liberated by adding 35 cc of formalin to 17.5 gm. of potassium permanganate, with all ports closed, is not noticeably affected.

The table also shows that the eggs from the reactor flock give slightly lower hatchability than those from the control flocks and that the fumigated eggs showed a hatchability about the same as the non-fumigated eggs. However, the differences are not significant and this amount of formaldehyde can be used to fumigate between hatches.

TABLE II—*The effect of formaldehyde fumigation on incubating eggs*

FLOCK	DATE SET (1929)	FUMIGATED			NON-FUMIGATED		
		EGGS	CHICKS	HATCH (%)	EGGS	CHICKS	HATCH (%)
Reactor	3- 9	95	56	58.9	96	51	53.1
Control	3- 9	96	50	52.1	96	53	55.3
Reactor	3-15	96	55	59.4	96	60	62.5
Reactor	3-15	75	37	49.3	75	40	53.3
Control	3-15	96	59	61.7	96	66	68.7
Reactor	3-22	96	45	46.8	96	48	50.0
Control	3-22	96	59	61.7	96	56	58.9
Reactor	3-29	96	56	58.9	96	42	43.8
Reactor	3-29	96	54	56.2	95	52	54.7
Control	3-29	96	58	60.4	96	59	61.7
Reactor	4- 5	96	40	41.7	96	40	41.7
Control	4- 5	96	58	60.4	96	58	60.4
Total Reactor		650	343	52.8	650	333	51.2
Total Control		480	284	59.2	480	292	60.9

FORMALDEHYDE FUMIGATION OF CHICKS

Complete sterilization of an incubator would seem to involve sterilization of the chick-down of the freshly hatched chicks as well as of the air and the incubator itself. This involves several difficulties since there must be a lethal dose at all times and the ports must be left open to allow for the proper exchange of air with the outside. The hatch usually extends over a period of from 18 to 36 hours. Thus the early hatched chicks would be exposed to the action of the gas over long periods of time.

Considerable time was used in attempts to develop a method suitable for continuous fumigation. Experiments were conducted

also with ports open and closed as well as with different relative humidities in the incubator air. In a few cases chicks several days old were used to determine the influence of age upon susceptibility to the action of the gas. The results of these experiments are reported in the following pages.

In the first experiment baby chicks, varying in age from one to ten days, were obtained from a local custom hatchery and subjected to formaldehyde fumigation to determine the effect of the gas.

It was found that exposure for one hour to 70 cc formalin killed 15 out of 18 chicks. In other experiments in which 35 cc of formalin was used, variable results were obtained. In two experiments in which chicks were exposed for one hour to 35 cc of formalin no apparent harmful effects were noticed. In another experiment, 10 out of 30 chicks died in three days. In the last case the chicks were ten days old, while in the other two cases, one lot was 24 hours and the other four days of age. Aside from a difference of one degree in the wet-bulb reading, all other factors were the same.

In the experiments conducted with all the ports open, the livability of the exposed chicks was not affected where 20 and 50 cc of formalin were used. In another experiment, eight out of 20 chicks died as a result of too severe fumigation. In this experiment, a pan 14 x 19 inches, containing 2,000 cc of formalin, was placed in the bottom of the incubator. Approximately 70 cc of formalin were evaporated every hour. This amount seemed to be very irritating to the chicks. Later a beaker with a diameter of 7¼ inches was partly filled with formalin and placed in the heating compartment of the incubator. From 10 to 15 cc of formalin evaporated every hour. Chicks fumigated with this amount for 18 hours were not injured.

The results of these experiments indicate that the use of 35 cc of formalin liberated by 17.5 gm. of permanganate will injure chicks if exposed for periods of one hour. Shorter periods of exposure are less injurious. The chicks which are already affected with *S. pullorum* are more severely injured than normal chicks. It is evident that this method of fumigation will not cure chicks already diseased. The "pan" method of fumigation is not so satisfactory as the vaporization method.

The Use of Ultraviolet Light for Disinfecting the Incubator

The question of the use of ultraviolet light for the sterilization of the air of incubators was early suggested to us. Some experimental work had already been undertaken for the sterilization of air by ultraviolet light with encouraging results. In considering this problem it was realized that the lack of uniform distribution of the light throughout the machine and the short penetrability of the light would be serious handicaps in its efficient use. However, a few experiments were conducted to determine the value of the ultraviolet light for this purpose. The lamp used was a Cooper-Hewitt, air-cooled, quartz-mercury-arc, 220 V.

Table III.—*The effect of ultraviolet light on S. pullorum*

	Time Exposed (Min.)	Growth of S. Pullorum on Exposed Down*		
		24 Hours in Broth	48 Hours in Broth	72 Hours in Broth
Experiment I	5	+	+	+
	10	+	+	+
	15	+	+	+
	10 (b)	+	+	+
	5	+	+	+
	10	+	+	+
	15	+	+	+
	Control	+	+	+
Experiment II	5	+	+	+
	10	+	+	+
	15	+	+	+
	20	+	+	+
	30	+	+	+
	40	+	+	+
	40†	+	+	+

*Growth on subsequent cultivation.
†Turned after exposure for one-half the indicated time.

D. C. type. The organisms were exposed about 24 inches below the lamp in layers as thin as possible in open Petri dishes. The lamp was surrounded by a cheese-cloth screen to prevent external contamination. The temperature increase was not sufficient to injure the exposed organisms. The results obtained by two series of tests are shown in table III.

In the first experiment, chick-down, contaminated with *S. pullorum* and dried, was exposed to ultraviolet rays for periods of five, ten and fifteen minutes. In one case the chick-down was placed under the ultraviolet ray lamp ten minutes after the lamp was started. After five minutes, the Petri dish was turned

over and the down exposed for five more minutes. In other cases chick-down was placed under the ultraviolet ray machine ten minutes after it was started and exposed for intervals of five, ten and fifteen minutes. In all cases growth occurred when the contaminated material was transferred to tubes of sterile broth, thus indicating that an exposure of *S. pullorum* on chick-down for five, ten and fifteen minutes to ultraviolet rays is not sufficient time to kill the organism. A second experiment was conducted wherein the length of exposures was increased to 40 minutes. The results were the same.

These results emphasize the fact that the ultraviolet ray cannot be used for disinfecting the air of forced-draft incubators. This is because of its very slight penetrating power through an opaque object.

The Influence of Relative Humidity on the Circulation of Microorganisms in the Air of Forced-Air Draft Incubators

Realizing that very little added weight would overcome the buoyancy of the chick-down suspended in the incubators, experiments were conducted to see what effect an increase in relative humidity would have on the circulation of chick-down.

The effect of an increased relative humidity on the circulation of suspended chick-down was determined by exposing agar, plated at intervals of one and five minutes, at various wet-bulb readings. The colonies of bacteria and molds appearing on the exposed agar plates give a fair index as to the number of circulating organisms in the incubator air.

The humidity has a very marked influence as indicated by the figures given in table IV. The machine in which the plates were exposed were fairly free from dust and had not contained eggs or chicks for nearly three months.

A comparison of the results obtained in the different incubators shows quite a variation in the colony count on the agar plates. However, this is no more than should be expected, for the least disturbance in the normal circulation of the air in the incubators, such as might be brought about by a fluctuating electric current supplying the fans, a flapping canvas curtain, or a person walking in the incubator, might stir up chick-down or dirt that had settled out of the air. Consequently, only a general average of the total bacterial count in all the incubators should be considered.

The results of the experimental work are shown in table IV. Counts were made of both molds and bacteria, since the molds were in the spore stage at the time of the exposure and each colony of mold probably represented one spore in most cases.

A comparison of the decreases in the number of colonies of bacteria, when the humidity is increased, indicates that the more thoroughly the air in the incubator is saturated the greater is the decrease in the number of circulating bacteria. Thus when the wet-bulb reading is 94° F., there is a decrease of 27, 72, 87,

TABLE IV.—*Effect of relative humidity on the circulation of bacteria and molds in a Buckeye incubator*

Wet-Bulb Reading (F.)	Dry-Bulb Reading (F.)	Colonies of Bacteria and Molds Appearing on Plates							
		One-Minute Exposure				Five-Minute Exposure			
		Plate No. 1	Plate No. 2	Plate No. 3	Total	Plate No. 1	Plate No. 2	Plate No. 3	Total
71.0°	99.5°	30	22	21	73	79	64	67	210
80.0°	100.0°	15	14	20	49	50	47	45	142
85.0°	100.0°	6	10	4	20	18	17	30	65
90.0°	100.0°	3	2	5	10	10	9	4	23
94.0°	100.0°	1	1	2	4	4	8	6	18

Wet-Bulb Readings	Decrease in Colonies between Wet-Bulb Readings (%)	Wet-Bulb Readings	Decrease in Colonies between Wet-Bulb Readings (%)
94–90	40	94–90	27
94–85	80	94–85	72
94–80	91	94–80	87
94–71	94	94–71	96
90–85	20	90–85	64
90–80	30	90–80	83
90–71	76	90–71	41
85–80	80	85–80	54
85–71	81	85–71	73
80–71	5	80–71	32

and 96 per cent in the number of colonies when exposed for five minutes, compared with the number when the readings are 90, 85, 80, and 71° F., respectively.

SUMMARY AND CONCLUSIONS

Formaldehyde fumigation, regardless of whether all ports are closed or left open, will satisfactorily sterilize incubators of the forced-air draft type. With a temperature of 99 to 100° F. and a wet-bulb reading of approximately 90° F., 0.35 cc formalin liberated by 0.175 gm. potassium permanganate per each cubic

foot of space, kills practically all exposed *S. pullorum* organisms within five minutes after the formaldehyde has been liberated.

The germicidal efficiency of formaldehyde gas is greatly influenced by the relative humidity. When the amount of moisture is decreased, the germicidal efficiency of formaldehyde is decreased. In addition, a relative humidity above 50 per cent largely prevents the formation of paraformaldehyde when the incubator is operated at 99-100° F.

Three fumigations of hatching eggs with 0.35 cc formalin per cubic foot for one hour each at weekly intervals, with all ports closed, did not injure the hatchability of the eggs.

Continuous fumigation with the pan method of evaporating the formaldehyde was found impractical. The m.l.d. of formaldehyde liberated by the hot-plate method was found to be between 60 and 70 cc of formalin per hour.

Experiments dealing with formaldehyde fumigation show that a forced-air draft incubator can be successfully sterilized without injuring the hatchability of the eggs. In addition, other experiments reveal that it is not feasible to keep the machine sterilized either by continuous fumigation or discontinuous fumigation without injuring the hatching chicks, as long as the chicks are left in the incubator for 36 hours.

Chicks subjected to one short exposure of formaldehyde, liberated from 0.35 cc of formalin added to .175 gm. potassium permanganate per cubic foot air space, with a wet-bulb reading of 90° F., are apparently not injured.

Chicks fumigated with formaldehyde liberated by the hot-plate method at the rate of 60 cc of formalin per hour for 8½ hours, and 55 cc of formalin per hour for 36 hours were severely injured. Likewise chicks fumigated by means of the formalin-potassium permanganate method, with 40 cc of formalin every 1½ hours for 36 hours and with 40 cc of formalin every three hours, either died or were greatly injured.

In determining the m.l.d. of formaldehyde gas by the formalin-potassium permanganate method in the Smith incubator, it was found that the dose per volume was approximately the same as for the Buckeye machine.

The use of ultraviolet rays was found to be unsatisfactory in sterilizing chick-down contaminated with *S. pullorum*. This work should be continued with other types of lamps and under other conditions in order to be conclusive.

Experiments with electrical precipitation of suspended chick-down demonstrated that the latter does not carry either a negative or a positive charge, thus making it impossible to remove it by this method.

Relative humidity was found to have a very decided effect upon checking the circulation of chick-down. Maintaining a wet-bulb reading of 89 to 90° F. in the Smith incubator resulted in a decided decrease in the number of circulating particles of material as compared to a wet-bulb reading of 83° F.

Unfortunately, there was no opportunity to determine whether the removal of chicks from the incubator, after they had been fumigated two, three, or more times by the discontinuous method, would successfully maintain a sterile machine without injury to the hatching chicks. Then, too, time did not permit the completion of the experiments dealing with the effect of increased relative humidity on the control of suspended material in the circulating air.

Two other experiments dealing with the control of a constant relative humidity in the Buckeye and in the Smith incubators were only partially completed. An automatic device which would maintain a constant humidity at any point above the relative humidity of the incubator room was developed for the Buckeye machine. However, it was only roughly constructed and needed a few alterations and adjustments before it could be used in the commercial field. A method of automatically controlling the introduction of steam into the Smith machine so that a constant humidity could be maintained was planned and considered feasible. Lack of time prevented the completion of both experiments.

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THE SLIDE AGGLUTINATION TEST IN THE DETECTION OF BACILLARY WHITE DIARRHEA*

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The slide or rapid agglutination test, as applied to the detection of bacillary white diarrhea by Runnells, Coon, Farley and Thorp,[1] is being widely used. Several reports concerning this test have recently appeared. Results obtained at the California Experiment Station[2] indicate that the slide method equals the tube test in efficiency. Stafseth and Thorp[3] found that different antigens varied in sensitivity. However, when a suitable antigen was used, the results obtained by the slide test agreed closely with the tube test. Bushnell[4] concluded that "the rapid slide macroscopic agglutination test is probably as efficient in detecting reactive fowls as the tube method and can be used as a substitute for the latter." Bushnell and Brandly[5] found the slide test very effective in the detection of reactors. Work at the Wisconsin Experiment Station[6] indicates that the slide method is equally as efficient as the tube method.

Since the results which we have obtained by the use of this method are not in full agreement with the observations cited above we have thought it worth while to present them here.

EXPERIMENTAL WORK

The results to be reported have been obtained through the repeated testing of a flock of hens. This flock has varied in number from 50 to 125. The birds have been tested at monthly intervals. Both slide tests and tube tests have been performed. Two dilutions have been employed in the tube test: 1 to 40 and 1 to 80. Partial agglutination in a dilution of 1-40 was considered indicative of infection. The antigen used in the tube tests was a suspension of *Salmonella pullorum* in carbolized saline. The turbidity of the antigen was 0.5 on the McFarland scale. Duplicate tube tests were run using antigen to which one per cent of normal sodium hydroxide had been added.

The antigen used in the slide tests was prepared according to recommendations of Runnells, Coon, Farley and Thorp.[1] Three

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strains of *S. pullorum* were used in the preparation of the antigen. These strains were the same as those used in making antigen for the tube test and were known to furnish satisfactory antigen for the agglutination test. The concentration of the antigen used in the slide tests was 50 times the concentration used in the tube tests. In performing the slide tests, 0.02 cc of serum was placed in contact with 0.02 cc of antigen and thoroughly mixed. After a brief period of warming the slide, the readings were taken. The sera which gave negative reactions at this reading were subjected to additional stirring and a second reading was taken. Although Bushnell and Brandly[5] warn that continued stirring tends to create positive reactions which cannot be confirmed by the tube method, we have found that additional stirring of initial negative reactions has resulted in a much better correlation than when this procedure is not used.

Using the two methods, we have tested 1150 samples of serum. The results of these tests are as follows:

Tube agglutination positive	Slide agglutination positive	682
	Slide agglutination negative	96
Tube agglutination negative	Slide agglutination positive	12
	Slide agglutination negative	360

The coefficient of association, according to the method of Yule, is .94+. The two methods agree in 90.6 per cent of the tests. The above figures seem to indicate that the tube test gives a larger number of reactors than the rapid test.

If the sera of different agglutinative titers be considered separately, a very interesting correllation is brought out. The results obtained with sera of different titers are given separately:

Agglutination complete at 1–80	Slide test positive	582
	Slide test negative	6
Agglutination complete at 1–40, partial but not complete at 1–80	Slide test positive	51
	Slide test negative	18
Complete agglutination at 1–40, no agglutination at 1–80	Slide test positive	20
	Slide test negative	16
Definite but incomplete agglutination at 1–40, no agglutination at 1–80	Slide test positive	29
	Slide test negative	56

From the summary given above it may be seen that when sera giving a complete agglutination at 1–80 or higher are tested, the agreement obtained with the two methods is nearly 99 per cent. However, as the agglutinative titers of the sera decline

the percentage of agreement becomes markedly less. In this work we have considered the presence of definite agglutination at a dilution of 1–40 as indicative of infection. Several of the birds whose sera give incomplete agglutination at 1–40 have been examined and found to be carriers of *S. pullorum*. Therefore, we feel that we have not been too rigid in the application of the tube method.

It is obvious that the antigens used in the slide tests were not sufficiently sensitive to detect all the infected birds. We are at a loss to account for this lack of sensitivity. Commercial antigens have been compared with the antigens prepared in the laboratory. We have found our own preparations more sensitive than the commercial antigens. If the commercial preparations had been used throughout the course of the investigation, the degree of correlation would have been even less than we have found it. Both fresh antigen and antigen which had been held in the ice box for some time were used. The results obtained with the fresh antigen were not perceptibly better than those obtained with older preparations.

Some mention should be made of the twelve sera which were positive to the slide tests and negative to the tube tests. Repeated re-testing of these birds by both methods has demonstrated that in eleven instances the birds were really negative reactors. One of these twelve tests represented a bird which was later positive by both methods.

SUMMARY

The antigens which we have prepared for use in the slide agglutination test, and commercial antigens which we have examined, have been found lacking in sensitiveness. The slide test has been found quite satisfactory in detecting birds whose sera caused complete agglutination in a dilution of 1–80 or higher. The slide test has been found less efficient than the tube test in detecting birds whose sera agglutinated in lower dilutions only.

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[3]Stafseth, H. J., and Thorp, F.: Studies of the agglutination and pullorin tests for bacillary white diarrhea as to the efficiency of each for detecting carriers of *Salmonella pullorum*. Jour. A. V. M. A., lxxii (1928), n. s. 25 (6), pp. 745-756.

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THE STICK METHOD OF CUTANEOUS VIRUS VACCINATION AGAINST FOWL-POX

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Since a previous paper[1] reporting on virus vaccination for the control of fowl-pox, investigations have been continued at the Oregon Experiment Station. Results warranted a definite recommendation in the spring of 1929 that virus vaccination by the "stick" method be applied to growing stock of suitable age on all farms in Oregon where the disease existed the previous year.

That methods developed at the Oregon Experiment Station have been successful and that the above recommendation is justified, is brought out by the increased demand for this work and the consistency in preventing spontaneous occurrences of pox. In this state approximately 5,000 fowls were vaccinated in 1926, 25,000 in 1927 and 50,000 in 1928. It is expected that nearly 100,000 will be vaccinated during the summer and fall of 1929. While accurate figures are not available, this number represents a high percentage of the fowls on farms where the disease occurred the past year. During the first three years, the work was done by the writer, to insure more accurate interpretation of results and at the same time prevent wide-spread unsatisfactory vaccinations because of insufficient information. This year vaccination is being carried on by others trained in the work with the exception of a few commercial flocks which are being vaccinated by the writer, as a control on virus sent out to others, as well as to obtain further information relative to fowl-pox virus.

This spring a three day school on fowl-pox vaccination was held at the Oregon State College. Instruction was given to both poultrymen and veterinarians. Upon completion of this course, an examination was given and the grades turned over to the State Live Stock Sanitary Board, which has been delegated by law to regulate the handling of virus. The Board granted permits to qualified poultrymen taking this course, to receive virus to vaccinate their own flocks. Veterinarians are, of course, given authority to handle virus when receiving a licence to practice.

Virus is sold by the Oregon Experiment Station in this state only, and only to those authorized to handle it. A charge is made

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sufficient to cover cost. This arrangement is necessary because it is not certain that present available commercial virus is satisfactory when applied by the method now recommended. When definite assurance on this point is available, this Station expects to discontinue such sales.

The work has resulted in the accumulation of considerable data which will be published later under conditions permitting more complete presentation. The purpose of this paper is particularly to discuss phases of the problem of especial importance in the practical application of virus vaccination by the method recommended in this state. The need for this has been emphasized by investigations here and frequent unsuccessful attempts at virus vaccination in some other states.

Three Methods of Virus Vaccination

The methods employed by the Oregon Experiment Station have been designated by the terms "scarification," "follicle" and "stick." While the stick method is the one recommended, nevertheless, a brief description of the other two is of value in better appreciating its advantages as well as one possible disadvantage, that of requiring a virus of greater potency.

The scarification method: This was used in most instances during the early investigations. This consisted in removing a few feathers external to the right tibia and applying virus suspension to this region with a camel's hair brush. This area was then scarified with an instrument recommended by the Dutch investigators, de Blieck and van Heelsbergen, for antidiphtherin vaccination. Since this method resulted in a good-sized pox scab and appeared to be accompanied by an excessive systemic effect, it was soon discarded. One redeeming feature of this method was that less care was necessary in the preparation of virus to insure takes.

The follicle method: This was then developed in an effort to reduce the severity of the reaction. The same region was selected as with the scarification method. The virus was introduced into one or more *open* feather follicles by *touching* (not brushing) them with the tip of a camel's hair brush. This left a small amount of virus suspension in each follicle touched. With satisfactory virus, touching two follicles results in practically 100 per cent of the fowls taking. One follicle take is sufficient to produce immunity. The object in applying the virus to more than one follicle is to reduce to a negligible number the percentage of fowls not taking.

This method was far from satisfactory when applied to fowls which had molted sometime previously, as in such cases it was difficult or impossible to find open follicles. Producing a break in the skin by mechanical means was then developed and called the stick method.[2]

The stick method: This overcame the objections to the follicle procedure and is the one recommended. The principle underlying the stick method is to produce a break in the skin and simultaneously introduce the virus. The area selected for making the stick is located external and posterior to the proximal end of the tibia (figure 1). This area is devoid of feathers and readily accessible. The right leg is vaccinated in all cases, as this simplifies the procedure of vaccination and checking for takes.

FIG. 1. Location of vaccination stick at X.

Several kinds of instruments were used for making the stick and a sharp-pointed blade, such as a number 6 B-R-X or number 11 Bard-Parker blade, was finally decided upon. The blade is wrapped with a small amount of adhesive tape and this in turn wrapped with fine thread so as to make an exposed point of $\frac{3}{32}$ of an inch. This wrapping regulates the depth of the stick as well as insures a small deposit of virus suspension for each stick. A 13-mm. serological tube, one inch long, with a small amount of cotton in the bottom, is used to hold a small amount of suspension while vaccinating. This tube is placed in a wooden block for convenience. A container for the virus is provided by a vial

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or serological tube with a medicine-dropper run through the cork. The cost of the materials for the stick method need not exceed thirty-five cents if a substitute for the regular blade-handle is made by attaching the blade to a piece of wood.

When applying stick vaccination, the suspension is thoroughly agitated with the medicine-dropper and enough added to the cotton in the small tube to saturate it and cause it to rise slightly above it. The point of the blade is dipped into the cotton before each stick, leaving a droplet of suspension. By carefully watching for the droplet one can determine when to add more to the tube.

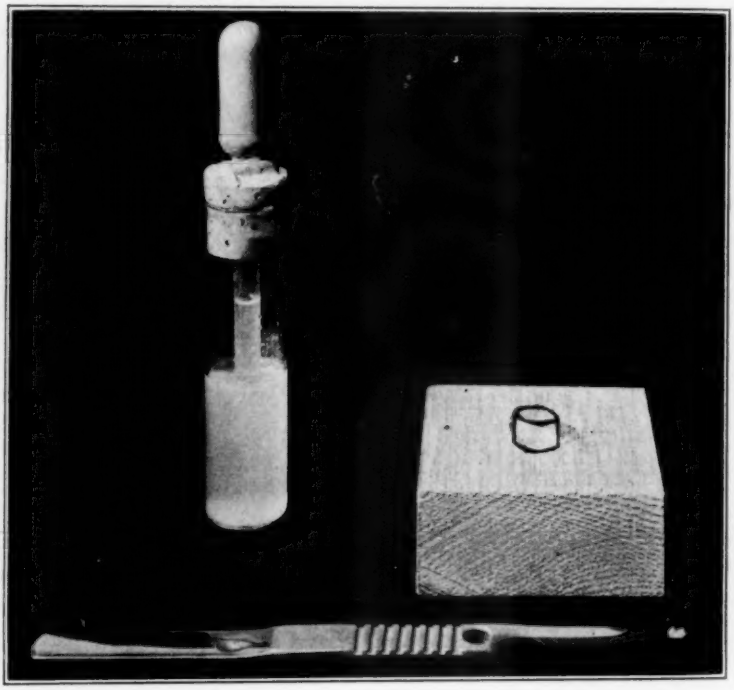

FIG. 2. Stick vaccination equipment.

When vaccinating it is desirable to have a substantial table about thirty inches high upon which to place a box a foot high. The one vaccinating either sits on the table or stands beside it. The fowls are placed across one corner of the box, right side uppermost and the legs directed towards the one vaccinating. The feathers are then laid upward and forward by the left hand of the vaccinator and pressure applied to the lower side of the tibia with the thumb, as this tends to tense the skin at the stick area and

also lessens the danger of sticking into the bone. The stick is preferably made crosswise of the leg and away from the feather follicles, as this eliminates the danger of spread. Suitable virus requires only one stick, while with questionable virus it is desirable to make more than one or perhaps resort to follicle vaccination. One stick vaccination has been made possible by the production of a virus that consistently retains its potency under practical field conditions. Considerable investigational work has been done in developing such a virus.

The virus should be protected from the sun to insure its maintaining the necessary potency. The one vaccinating does not hold the fowl, but confines his activities to exposing the stick area and handling the virus. If the fowls are properly placed and brought fast enough, a minimum of 600 can be vaccinated per hour. For average conditions four individuals besides the one vaccinating comprise a good crew.

The Virus

In the following pages the term virus refers to virus-containing material such as pox scabs in an entire or broken-up state. Where refrigeration is referred to, it is to be understood the temperature is approximately 7° C.

Considerable time has been devoted to a study of this phase of the problem, since there is a dearth of literature relative to it and it is so basic to consistent successful vaccination. One need not scrutinize very closely the various publications on fowl-pox vaccination to note the glaring lack of information on the characteristics of fowl-pox virus. The wholesale vaccinations which are being carried on at the present time, and no doubt in many instances with virus which has been prepared in ignorance of the necessary details, will result in numerous unsatisfactory vaccinations.

Production of virus: A distilled water suspension of finely ground pox scabs is used to inoculate the combs (upstanding) of disease-free S. C. White Leghorn cockerels. This is done by brushing both sides of the comb with a camel's hair brush dipped in the suspension. The comb is then scratched with a needle and the virus brushed on again. As a rule the pox scabs are removed two to four weeks after inoculation.

Preparation of scabs for making the suspension: In preparing scabs for routine field vaccination they are finely ground with a mortar and pestle in twenty-four hours or less after removal.

This material is then weighed into 17-mg. lots and each lot placed in a No. 5 gelatin capsule of 0.1 cc capacity and sealed with gelatin. The capsules are then placed in the refrigerator at about 7° C. and sent out upon order with the necessary amount of distilled water diluent for the number of fowls to be vaccinated and with an expiration dating of one week from the time of leaving the laboratory. The virus and diluent are not mixed when sent out.

The present routine practice is to prepare scabs fresh each month. This is being done as a special precaution against the use of scabs which would prove unsatisfactory. Undoubtedly changes will be made in the future, probably using scabs kept in the refrigerator for a few days to months, as a source of supply for the finely ground material to be sent out, rather than preparing fresh scabs each month. The expiration period on virus sent out will also probably be increased. These changes will be recommended only after an abundance of evidence has been obtained to substantiate them. The present procedure meets the needs in a very practical and convenient manner.

That the scabs may be dried for extended periods and still prove satisfactory for one stick vaccination is exemplified by virus 82028 of this laboratory. The scabs for this virus were removed August 20, spread on paper and left in a dark place for forty-four days, then placed in a small, tightly-corked vial, and kept at room temperature. Scabs taken from this lot February 8 (172 days after removal), finely ground in a mortar and the next day 70 mg. added to 12.5 cc of distilled water were used to vaccinate several flocks. Twenty days later, examination of 74 fowls in one flock revealed 72 with definite takes, a minimum efficiency of 97.3 per cent takes per total number of sticks. It is just possible that the two fowls were immune, as pox existed on the place at the time and, also, that these developed a reaction which subsided before the day of examination. The vial with the 82028 virus had not been opened for forty-eight days previous to February 8. Evidence of marked loss of viability occurred in forty-seven days after February 8, which may have been due to opening the vial.

Suspension produced by using 82028 virus to inoculate the combs of six hens and removed thirty days later, proved valueless for stick vaccination 102 days after removal. The customary dilution of this virus, used to inoculate both sides of the combs of two three-month-old cockerels, produced only one lesion.

Both of these fowls proved highly susceptible to inoculation with another virus later. The virus used for inoculation 102 days after removal had been left spread on paper, away from sunshine, for a period of 76 days. It was then placed in a small, tightly-corked vial, in the dark, at room temperature.

In view of the above examples, as well as others, it was decided to dry the pox scabs sufficiently to remove enough moisture to prevent decomposition and then place them in small tightly-corked glass containers, which would leave a small air space and minimize further evaporation.

Effect of Room Temperature and Refrigeration on Finely-Ground Scabs

The handling of the virus designated in this laboratory as 43029 best explains the reason for refrigeration. The 43029 virus was removed from the comb of a 3½-month-old S. C. White Leghorn cockerel, which had been inoculated thirteen days before, spread on paper and left in a dark place for twenty-four hours. At this time it weighed 2.32 grams. The virus was then divided into two lots about equally as to size and amount and each placed in 13 x 100 mm. serological tubes and tightly corked. Immediately one tube was placed at room temperature and the other in the refrigerator, both in the dark.

Nine days after removal, an equal amount of scabs was taken from each of the two tubes, finely ground in a mortar, divided into lots of 17 mgs. each and each lot sealed in a No. 5 gelatin capsule. These capsules were divided into two lots—one placed in the refrigerator and the other at room temperature. Both lots were kept in the dark.

One of the capsules kept at room temperature was used to make a 3.1-cc suspension forty-four days after removal of the scabs and thirty-five days after they were finely ground and sealed in the capsules. The suspension was used on the day of preparation to vaccinate a flock of 900 S. C. White Leghorn cockerels by the stick method—one stick each. Examination of fifty of these fowls fourteen days after vaccination revealed one take on each. Another capsule of this same lot was used on another flock in a manner similar to the above, but fifty-eight days after removal of the scabs and forty-nine days after they were finely ground and placed in capsules. Examination of 115 of the fowls in this flock, twelve days after vaccination, showed 97 with a definite take, two with questionable, and seventeen with no takes, or a minimum

take efficiency of 83.6 per cent. It is possible, but not probable, that those which did not take had been recently affected with pox and immunized. That these fowls were not immune was suggested by results obtained using another capsule of this same lot in a similar manner except for applying two sticks per fowl, seventy-three days after removal of the scabs and sixty-four days after finely ground. Examination of twenty-one fowls twelve days after vaccination revealed twelve with two takes, seven with one, and two with no take, or 73.8 per cent takes for all sticks.

One capsule of 43029 virus kept in the refrigerator was taken out and placed at room temperature forty-three days after removal of the scabs and thirty-four days since finely ground. After sixteen days at room temperature, this capsule was used to make a suspension for vaccination with one stick comparable to the above. Examination of fifty-five fowls selected at random out of this flock of 1500 revealed a take on each. A second capsule of 43029 virus, taken from the refrigerator eighty-two days after removal from the fowl and seventy-three days since finely ground, was used the next day to prepare a suspension to vaccinate a flock with two sticks per fowl, in a manner comparable to the above flock. Examination of fifty-one fowls eight days after vaccination revealed fifty with two takes and one with no take at all and no indication of having been vaccinated. Undoubtedly this fowl was not vaccinated, as three got away during vaccination and a few were not caught up before vaccinating. Refrigeration of the 43029 virus definitely increased the period during which the virus was effective in producing consistent takes. Refrigeration, therefore, is being used to prolong the period of usefulness of the virus for vaccination. This applies both to the virus in the original scab form as well as in the finely ground.

The fact that refrigeration prolongs the period of pathogenicity and that exposure of scabs to drying at room temperature destroys pathogenicity, offers a plausible explanation for the increased incidence of pox during the fall and winter in the Pacific Coast states.

Alteration of virus in finely ground scabs: Keeping finely ground scabs for a number of days at room temperature is definitely accompanied by alteration of the virus, judging by the takes produced. This has been repeatedly observed in our work. The takes produced by such virus are frequently distinct swellings of very moderate size and without scab formation. The problem of producing a virus showing uniformity of action in this respect

offers an important field for investigation. It seems probable that such a virus might be used to vaccinate fowls in lay and consistently without affecting egg-production.

Use of a virus in this laboratory designated as 62529 demonstrated very clearly the above-described modified takes. The scabs were removed nineteen days after inoculation and finely ground in a mortar twenty-seven and one-half hours after removal. This was weighed out in lots of 17 mgs. and each lot placed in a No. 5 gelatin capsule and sealed. These capsules were kept at room temperature in the dark for twenty-seven days. One capsule was then used to make the usual dilution and for customary vaccination with one stick. The examination of 114 fowls in this flock seven days after vaccination showed two fowls with no takes, one with a questionable take, and 111 with one definite take each. In connection with forty of the 111 fowls, over one-half of the takes showed as bumps without a scab at all and the remainder of the forty had barely a trace of scab. Thirty-seven had scabs larger than any of the above forty but of very moderate size. Thirty-four had moderate scabs slightly larger than those on the thirty-seven. The takes described as having a swelling without a scab have been noted in another flock fourteen days after vaccination, with virus finely ground and kept at room temperature for thirty-five days.

Preparation of virus suspension for vaccination: Distilled water is used as a diluent for the virus, as the indications are that this is the least harmful fluid. According to our data, physiological saline and dilutions of glycerin proved destructive to the virus.

In preparing the suspension the routine procedure is to add a capsule containing 17 mgs. of finely ground scabs to 3.1 cc of distilled water, or the capsule is opened and the finely ground scabs shaken into it and mixed by vigorous shaking. If the capsule is added, a few minutes should be allowed for it to soften and it may then be broken with the medicine-dropper or sharp instrument and the suspension thoroughly mixed by vigorous shaking. As soon as mixed, it is ready for use. The suspension should be made just before vaccinating and any left over discarded. When less than 3.1 cc of suspension is needed, the practice is not to reduce the amount of virus even though this might result in satisfactory takes. In those cases where experience with a given virus is lacking, it would perhaps be preferable to use more than 17 mgs. of finely ground scabs to 3.1 cc of diluent, since the added

cost is practically negligible and no disadvantage has been apparent as far as the reaction is concerned when this has been done.

Amount of virus used for vaccination: Repeatedly 2.5 cc of suspension has been sufficient to vaccinate 2,000 or more fowls, where one stick per fowl was made. On the basis of 17 mgs. of pox scabs to 3.1 cc of diluent, one gram of scabs should be enough to vaccinate approximately 150,000 fowls.

Vaccination of Turkeys

With the exception of one experiment, the work has been entirely confined to the chicken. This experiment was with turkeys and indicates their behavior following vaccination is the same. Three young poults, stuck once with virus from the chicken, developed one take each. A reverse inoculation, using virus from a turkey, had been carried out previously, with takes resulting, indicating still further the similarity of pox in these two kinds of fowl. These three turkeys proved immune to inoculation forty-one days after vaccination, while three controls inoculated with the same virus proved susceptible. These fowls showed no symptoms to indicate generalization and gained in weight at each weighing, which was twice a week.

When to Vaccinate

Virus vaccination is not to be recommended on farms where the disease has not occurred, except under circumstances which make it very likely that the disease will occur. Such a recommendation essentially would amount to advising vaccination of all fowls. Widespread immediate use of the method is to be discouraged, as this is likely to be accompanied by serious difficulties which may not be readily apparent at the outset.

Ideal conditions for vaccination are provided during the summer months while the fowls are on range and about a month before they are expected to come into lay. Slight modifications may be necessary in some parts of the country due to climatic variations and insect pests.[3] Also, the time of vaccination can not be definitely fixed because of such factors as having more than one flock on a farm, different ages and varying conditions of vigor.

Males of any age past the brooder stage, particularly above three months, may be successfully vaccinated. Pullets a month of age have been successfully vaccinated at the laboratory and seven and one-half weeks of age the youngest in the field, but this is not a practice to be recommended. It is not advisable to

vaccinate under three months of age except under unusual circumstances. Besides the fact that the fowls probably show a less marked systemic effect after that age, a very important point is that the older the fowl is beyond the brooding period the less the chances for acute intestinal parasitic trouble. It should not be lost sight of that losses which occur from any source after vaccination are likely to be attributed to vaccination by the average poultryman. Rather than vaccinate one flock at too early an age because of having an older one, it would be preferable to postpone this until the older fowls were laying a few eggs if this would meet the situation. There is no serious objection to this practice. It will probably hold the older fowls back somewhat in coming into production, but this is not infrequently desired by the poultryman, especially in the case of early hatched pullets. If the older fowls are far along in production, they may show a marked slump if vaccinated at that time. Consequently, rather than wait too long in the case of the older pullets in order to permit the younger ones to develop more, it would be advisable either to make two vaccinations or, if this is not practical, vaccinate both groups after the older fowls have begun to lay a few eggs, even though the younger ones have not as yet attained the most desirable size.

There is no particular objection to vaccinating flocks of growing fowls on the same farm at different times if they are distinctly separated. We have repeatedly done this successfully. The writer vaccinated two flocks on the same farm with an interval of a month and in which case there was some intermingling of the two flocks but no spread of pox from one to the other was apparent. This practice is not to be recommended except under unusual circumstances.

Vaccinating fowls during the molt is to be recommended if the disease appears in such a flock or in another on that farm that season, although it is not quite as satisfactory as when applied to growing fowls on range. It is preferable to vaccinate molters before they come into lay but after the feathers have had an opportunity to grow out fairly well on most of the fowls.

Virus vaccination in its present state of development is not to be generally recommended for infected or non-infected flocks in heavy lay and with the latter, on farms where the disease exists at the time. If the disease is just developing in a flock in heavy lay or one of several flocks on the same farm, and all producing well, one would be justified in vaccinating all the flocks,

as far as the disease itself is concerned. However, in cases of this kind, as much thought should be given to a study of the flock owner's attitude as to the flock conditions. The tendency is for the poultryman to misinterpret results and condemn vaccination when applied under such conditions. If the owner is capable of seeing the problem in the light of making the best of a bad situation, vaccination is advisable. Should the disease occur in part of the flocks at the peak of egg prices or when severe cold weather is in prospect, postponement of vaccination for a short period may be justifiable in the case of the non-infected flocks. If this is done, rigid sanitary measures should be practiced.

Results have been obtained from time to time in connection with vaccination of laying fowls which lend considerable encouragement to this practice. One flock of about 350 pullets coming into production was vaccinated with one stick. At that time they were producing about 120 eggs a day. When generalization from vaccination occurred, production dropped to a low point of 90 eggs daily for a few days and then gradually increased again. Maintenance of such a production indicated a very mild generalization. Examination of twenty-five fowls by the owner and taken at random from the flock, revealed a take on each one.

In another instance twenty pullets which has been maintaining fifty per cent or better production for months were vaccinated with four sticks, with a take for every stick. The percentage production for thirty-two days after inoculation was as follows: 70, 50, 65, 85, 70, 65, 60, 60, 60, 75, 75, 25, 55, 50, 30, 45, 30, 45, 55, 35, 45, 30, 40, 50, 25, 50, 35, 40, 60, 53, 53 and 53. After this period an average of over 50 per cent production was maintained. A distinct drop in production occurred on the twelfth day after vaccination but this followed two days of high production. The average production for eleven days after vaccination was 67 per cent and for the twentieth to the twenty-fifth days, inclusive, 37.5 per cent, which was the lowest production for a six-day period. Control fowls in this pen, vaccinated six and one-half months previously, were stuck four times and continued in normal lay. It is particularly interesting to note that the trap-nest records show ten fowls of the twenty, vaccinated for the first time, produced from eighteen to twenty-seven eggs each for thirty-one days, beginning two days after vaccination. Three out of this group of twenty died during this month, one was affected with blindness of the type frequently associated with

paralysis, and no cause was definitely determined in the two others.

The above two flocks were vaccinated July 7 and April 29, respectively. It is not improbable that vaccination at a time of the year when weather conditions are more unfavorable would have been followed by less favorable results.

Sometimes growing fowls which have previously developed spontaneous pox are considered for vaccination. The question in this case is whether or not a large enough percentage were affected to justify not vaccinating. This question can be determined with reasonable accuracy by segregating and vaccinating part of the flock. Those which have been affected some time in the past show a pronounced swelling in forty-eight to seventy-two hours, which reaches its maximum in approximately ninety-six hours. The swelling then gradually subsides and a small, thin scab falls off in about ten to twelve days. Those which have not been affected usually do not show a pronounced swelling until ninety-six hours or later and which as a rule does not reach its maximum until several days later. Scab formation progresses until about two weeks after vaccination, at which time they begin falling off and continue up to about a month.

Examination for Takes

Examination for takes should *always* be made. A week to ten days after vaccination is a suitable time, as the takes should then show distinct swelling and scab formation. Some lesions are slow in developing and do not show a reaction which is readily recognized by the average inexperienced individual until five to seven days after vaccination. Take scabs frequently start dropping off two weeks after vaccination; and while the lesions are definite, even at that time examination by those inexperienced is not satisfactory.

If a considerable percentage of fowls show a lack of takes, one should consider the quality of the virus and the possibility of the fowls being immune because of previous spontaneous infection. Fowls which show no definite takes and are thought to have had pox previously can be definitely placed if the type of lesion is studied as to the characteristics previously described.

If one has reason to question the susceptibility of a flock before vaccination and not be in a position to obtain definite information at the time, a part of the fowls can be marked and stuck twice. A practical method of marking is to use an alcoholic solution of

methylene blue. With a medicine-dropper apply a little of the fluid to the feathers of the head or back and the fowls are readily singled out. If an active, concentrated virus is used, the fowls should almost without exception show two takes each. If the virus is not sufficiently active and concentrated, one can expect to find a percentage with two, one and no takes at all, the percentage of each depending upon the degree of inactivity or lack of concentration of the virus.

If for any reason twenty-five per cent of the flock do not take and remain susceptible, it would be advisable to re-vaccinate.

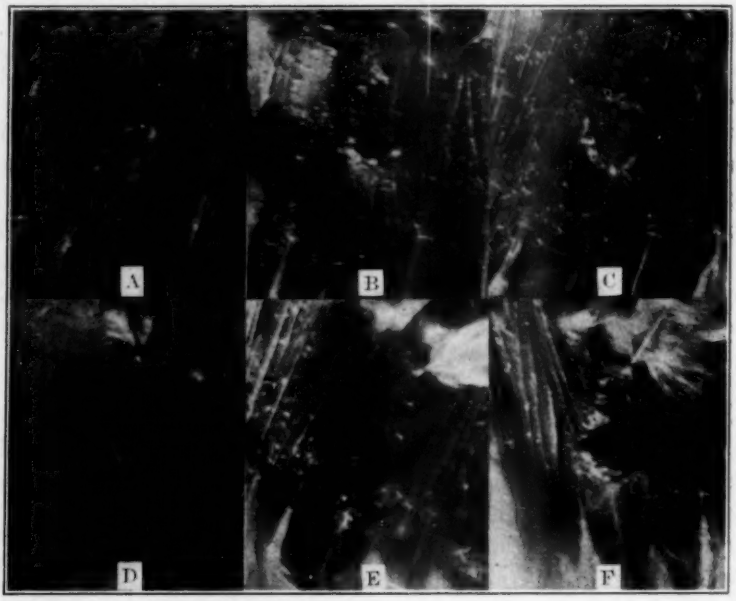

FIG. 3. Stick vaccination takes. A, B and C are 7-, 10- and 16-day lesions, respectively, of one fowl. Take scab has fallen off of lesion illustrated by C. D, E and F are 7-, 10- and 16-day lesions, respectively, of a second fowl. Take scabs all present.

AFTER EFFECTS OF VACCINATION

Some flocks give no evidence of a systemic effect following vaccination. As a rule, they can be expected to show a decrease in appetite about the end of the second or during the third week. This reaction is of no particular concern in growing fowls in that it is only of a few days' duration. When the scarification method was used, generalization with loss of appetite and general inactivity regularly occurred.

Occasionally a distinct mortality occurs and it is impossible in some cases to establish that the loss is or is not due to vaccina-

tion. In those instances where no other cause can be found, the common assumption is that vaccination is responsible. This is obviously an unfair attitude, in view of the fact that it is common, in the case of unvaccinated flocks, to find a heavy mortality occasionally, in connection with which no cause can be found. With our present knowledge, it can be safely stated that it is not certain any mortality is resulting from vaccination outside of isolated cases of canker of the larynx, which certainly constitutes a very small fraction of one per cent under Oregon conditions.

Development of Immunity

There is apparently no important difference in the period required to develop immunity between one or more sticks. This is indicated by results obtained with seven mature Barred Rocks vaccinated by the stick method—three with one stick, three with two sticks, and the seventh not vaccinated but used as a control. These fowls were obtained from a flock where no pox had been seen and were vaccinated the day after being brought to the laboratory. The six developed takes in accordance with the vaccination. Twenty days after vaccination, each fowl, including the control, was inoculated on the comb and leg by scarification. The six proved immune to this inoculation and the control proved highly susceptible.

Some fowls have not shown complete immunity to an inoculation four weeks after extensive vaccination and others have proved immune to an inoculation fifteen days after a comparatively mild vaccination, such as one follicle. Immunity to an inoculation twenty days after vaccination, such as shown by the above six fowls, is probably about the average time required regardless of the degree of vaccination.

Duration of Immunity

All fowls evidently develop a complete immunity following virus vaccination if sufficient time has elapsed. The data definitely establish that this complete immunity is not permanent and that apparently all fowls showing complete immunity at one time develop a degree of susceptibility later. This susceptibility applies to both the comb and feathered parts. This has been established in fowls which had developed spontaneous pox as well as vaccinated ones. A slight but distinct susceptibility, in a previously completely immune fowl, has been demonstrated to an inoculation six weeks after complete immunity was

determined. Not only is this susceptibility shown to one inoculation, but it has been demonstrated repeatedly in the same fowl.

This susceptibility is apparently of no economic significance since a distinct resistance continues for extended periods and probably for the life of the fowl. A group of pullets inoculated with four sticks, 195 days after vaccination with one stick, continued in normal lay following these inoculations. Control fowls inoculated by sticking four times showed a slight but distinct drop in egg-production. This experiment was conducted in the spring which favored a normal lay, but the results are significant nevertheless, in view of the fact that this influence operated for both groups.

No significant difference in susceptibility was noted to an inoculation in a group of three fowls vaccinated two years and eight months previously by scarification and another group of four fowls vaccinated six months previously by one stick.

The stick method of inoculation affords a very sensitive test for susceptibility.

Introducing the virus into a very few scratches, which are distinctly separated, provides a good test of comb susceptibility. This is much preferable to extensive scarification. As in the case of the regular pox reaction in a highly susceptible fowl, the reaction of the comb is less rapid than the skin of the feathered part of the body. The lesions produced by inoculation of the combs of fowls which have been completely immune previously, contains virus capable of producing marked pox lesions in other fowls.

Outbreaks of Pox and Sale of Vaccinated Fowls

Virus vaccination raises an important question in connection with the sale of fowls from farms where it is being applied. Regulation of shipments from such farms is essential if the poultry industry at large is to be protected as it has a right to be.

The advice given to Oregon poultrymen has been to sell no vaccinated fowls until two months have elapsed following vaccination. This statement has been more or less arbitrarily made to meet a practical situation. It is possible that modifications will be made after further data are available. With the stick method the take scabs begin falling off in about two weeks and continue up to about a month after vaccination. After the take scabs fall off, some virus-containing material still remains on the fowls but this is in such small particles that it very soon

becomes thoroughly dried. It is reasonable to expect it to take a month for these particles either to fall off or for pathogenicity of the virus to be destroyed. Some data are available to furnish a guide in this matter.

In one case, previously mentioned, pox scabs removed from the combs of several fowls, placed on paper to dry for seventy-six days and kept away from sunshine, proved worthless for stick vaccination 102 days after removal of the scabs, as no takes were produced. They were placed in a tightly corked vial seventy-six days after removal and then in the dark until used for the above vaccinations. Using some of these scabs to inoculate, by scarification, the combs of two S. C. White Leghorn cockerels three months old resulted in only one small lesion of pox. With other virus these fowls proved highly susceptible and developed a mass of pox lesions on both sides of the comb. It is obvious that these scabs were larger and thicker than those resulting from stick takes and many times thicker than the pox-carrying particles remaining on the fowls a month after vaccination. This probably shortens the period of viability considerably.

The question of persistent carriers of pox must receive consideration in deciding upon quarantine measures. Some information was gained on a farm where a severe outbreak of pox had occurred. The flock of hens on this farm which was affected from six months to a year previously was mated with eighteen cockerels from a farm where no pox had been observed. No pox has been observed in the flock of hens since the original outbreak. Four of the cockerels were removed for inoculation after they had been mated with the hens for six months. All four proved highly susceptible, which was taken as positive proof they had not contracted pox from the hens. In addition, six of the hens were inoculated and proved previous infection.

The carrier problem was studied from another angle and an attempt made to determine whether or not the blood of vaccinated fowls harbored pox virus sometime afterwards. In this instance, two groups of three fowls each were vaccinated by the follicle, method introducing the virus into three follicles on each fowl. Twenty days later about 1.5 cc of blood was drawn from the wing of each and thoroughly agitated to prevent clotting. Two composite samples were made, each constituting the blood of one group. These fowls were inoculated immediately after the blood was drawn and proved to be immune. Both legs of two susceptible fowls were plucked over a considerable area and the defeath-

ered parts of one fowl's legs swabbed with cotton saturated with blood from one sample and the legs of the second fowl similarly treated with the other. The same day these two fowls were inoculated with virus in feather follicles on the back, anterior to the tail, and typical pox lesions developed. No lesions developed on the legs to indicate that the blood used contained virus. This is an apparent contradiction to results obtained by Sanfelice,[4] who claims to have "demonstrated virus in the spleen, lungs, liver and kidney, in the last two organs, twenty-four hours after a successful inoculation upon the skin. It was likewise present in the internal organs seventy-one days after inoculation."

Demonstrating the Effectiveness of Vaccination

It is sometimes desirable to demonstrate to a poultryman the immunity produced by virus vaccination. This can be done by segregating a few unvaccinated fowls. Three to five weeks later, a few vaccinated fowls which have taken may be re-vaccinated, or preferably inoculated on the comb, and the segregated fowls similarly treated. The results are convincing. In an occasional fowl complete immunity is not established against an inoculation a month after vaccination. But in all cases checked to date at this laboratory, they have been either immune or highly resistant. Most fowls are immune to an inoculation three weeks after vaccination.

Summary

A highly satisfactory method of cutaneous virus vaccination for the control of fowl-pox and called the stick method is described. It is briefly compared with the scarification and follicle methods. The method has been applied almost exclusively to the common domestic fowl but its limited use on turkeys is also considered. The small amount of virus used, rapidity of application, and uniformity of takes especially commend it. The success of the method hinges on the use of a highly potent virus, concerning which information is given as to its preparation and care. Such phases as when to vaccinate, examination for takes, after-effects, development and duration of immunity, sale of vaccinated fowls, and demonstrating the effectiveness of vaccination are discussed.

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CLINICAL AND CASE REPORTS

(Practitioners and others are invited to contribute to this department reports of unusual and interesting cases which may be helpful to others in the profession.)

POULTS SUSCEPTIBLE TO BACILLARY WHITE DIARRHEA

By M. W. EMMEL, *East Lansing, Mich.*

Michigan Agricultural Experiment Station

During the past season we have had an increasingly large number of diseased poults coming to our laboratory for diagnosis. Lesions were often absent and in an effort to determine the cause of the condition we began to culture all of the organs of autopsied poults.

Salmonella pullorum was isolated from six poults from a total of three flocks. The organisms were isolated from the lungs of four poults, livers of five poults, hearts of two poults and from the intestines of all of the birds. The poults ranged from two to three weeks of age. The birds from two flocks were being raised with baby chicks which later showed evidence of bacillary white diarrhea. We were unable to obtain any history of the third flock.

It is generally conceded to be a bad practice to raise turkeys with chickens, on account of blackhead, and this should be evidence that young poults should not be allowed to run with young chicks.

OMPHALITIS IN BABY CHICKS AND TURKEYS*

By FRITZ VOLKMAR, *Fargo, N. D.*

North Dakota Agricultural Experiment Station

Diseases of the navel in poultry have received little attention in avian pathology. Having had occasion to make a number of autopsies on baby poultry in recent years, I was able to trace a series of outbreaks of baby chick and baby turkey mortality to inflammation and infection of the navel. For a clearer understanding of the pathology of the disease, I shall first outline some of the peculiar embryonic and anatomic features involved in chickens.

*Received for publication, September 18, 1929.

At about the twentieth day, the yolk sac, which so far has been outside the chick embryo, is withdrawn into the abdominal cavity. As the chick picks through the shell on the twenty-first day, the umbilicus becomes occluded. The yolk now forms the food reservoir for the following seventy-two hours of the life of the new-born chick. The endothermic lining of the yolk is highly vascularized. These vessels aid in dissolving and absorbing the yolk. The nourishing material is carried by the vitelline veins to the liver, where it is mixed with the blood drained from the intestines by the portal veins. This blood is finally carried by the posterior vena cava into the right auricle of the heart.[1]

However, through some influences as yet unaccounted for, either inherent in the constitution of the parent, such as inbreeding, or influences upon the egg or eggshell during incubation, such as faulty humidity, the navel does not close at the time of hatching in a large percentage of the chickens or turkeys, thus inviting infection from insanitary surroundings, such as contaminated floors, etc.

The symptoms and lesions observed are similar to those reported by Hebrant and Antoine.[2] The anamnesis brings out the fact that the little chicks exhibit drowsiness and indifference to their surroundings and they appear puffed up like balls; diarrhea may be present at times. The age of the dead birds ranges from three to ten days. Taking the *status praesens*, the one constant lesion found is a small scab over the navel. This scab may vary in size from a pinhead to a pea. On loosening this scab, a fissured ulcer appears beneath it. On autopsy, the yolk is always found unabsorbed and more or less flocculated or inspissated. The liver presents a pale yellow color, resembling ochre. The gall-bladder is enormously enlarged and distended; the gall, itself, is of much higher viscosity than normally.

It is easily understood that bacteria gaining entrance into the navel will find there a highly suitable medium in the undigested or residual yolk, and the avenues wide open for causing a general pyemia or septicemia, depending, of course, on their falcultative pathogenic properties. Bacteriological examinations thus far have not revealed any specific infection, but invariably a variety of different bacteria had been found on culture. Rasberger,[3] however, in an outbreak of navel inflammation among baby pigeons, found the virus of avian diphtheria as the etiological factor. In one of my cases, *Salmonella pullorum* has been identified by means of fermentation reactions, but it was not investi-

gated whether *S. pullorum* was acquired through the navel and the cause of the navel infection, or whether the navel infection was secondary to an egg-borne bacillary white diarrhea.

It is rather significant that the disease occurs in an epornitic form exclusively in incubator-raised chickens. The increase of the bacterial content of the air at hatching-time, due to the moisture content and the temperature in the incubator being at the optimal point for various bacteria, especially those of the colon-typhoid group; the small cubic volume of air allotted to each bird, resulting from the crowding in such a small area, and the increasing tendency to keep the baby chicks in the incubator up to seventy-two hours instead of the customary twenty-four—these are obviously some of the factors which tend to give the outbreak catastrophic proportions.

It follows that, aside from the selection of eggs from healthy stock, such sanitary precautions as the use of properly disinfected incubators and brooders and daily disinfection or cleaning of the floor space provided for the chicks after hatching, together with the disinfection of all unoccluded navels, will constitute the principal prophylactic measures. Removal of the scabs and repeated treatment of the ulcers with tincture of iodin or with bichromate of mercury have given satisfactory results to flock-owners.

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[2]Hebrant and Antoine: Sur les causes de la grande mortalitée des poussins observée cette année en Belgique. Ann. Méd. Vét., lxii (1913), p. 369.
[3]Rasberger: Ueber nabeldiphtherie und fibrinoese gerinnungen bei voegeln. Muench. Tierärzt. Wchnschr., lxxv (1924), pp. 152-156.

Misbranded Products Removed from the Market

An extensive investigational survey has recently been completed on antiseptics for human and animal use by the Food, Drug and Insecticide Administration of the United States Department of Agriculture. More than a thousand products recommended by their manufacturers for a large variety of conditions were investigated. It was found that many of these products were misbranded, a number bore false claims, and a few were found whose manufacturers had never tested their efficacy. As a result of the survey many producers were forced to change their labels to comply with the regulations covering claims for such products, while forty-five so-called antiseptics were removed from the market. A similar survey, which included insecticides, fungicides and disinfectants, also was conducted. It is welcome news that these surveys will be continued in an effort to keep only dependable products on the market.

ABSTRACTS

FOWL PARALYSIS (Neurolymphomatosis gallinarum). Alwin M. Pappenheimer et al. Jour. Exp. Med., xlix (1929), p. 63.

Fowl paralysis is a disease entity, with characteristic clinical and pathologic features. The disease occurs in all parts of the United States, Holland, Austria, and probably South America. The disease seems to be enzootic in certain foci. Having once appeared, the disease tends to persist through successive years. It occurs with about equal frequency in both sexes; all common breeds may be affected. Symptoms appear between the third and eighteenth months. The conspicious symptoms are asymmetrical, partial and progressive paralysis of the wings and both legs and rarely of the muscles of the neck; occasionally, grey discoloration of the iris with blindness. Nutrition is usually preserved. The duration is variable; the outcome is usually fatal, but spontaneous recovery may rarely occur. The principal pathologic changes are found in the nervous system. In the peripheral nerves the essential feature is an intense infiltration of lymphoid plasma cells and large mononuclears. This is accompanied by a myelin degeneration in the more advanced lesions, but the cellular infiltrations appear to precede the degenerative changes. In the brain, cord and meninges, there are similar infiltrations predominantly perivascular. Infiltrations of the iris with lymphoid and plasma cells are found in the cases showing gross discoloration of the iris. Visceral lymphomas, originating usually in the ovary, are associated in a certain percentage of the cases. Evidence is presented in favor of the view that this association is not accidental and that the lymphomas are a manifestation of the disease. Infiltrations of the spinal cord and brain, rarely the peripheral nerves, are frequently present in birds showing no clinical symptoms. These are interpreted as mild cases of the same disease. No micro-organism of etiologic significance has been demonstrated in the tissues or by cultural methods.

FOWL POX ANTISERUM. Dalling, Mason and Gordon. Brit. Jour. Exp. Path., x (1929), 1.

Fowls can be so immunized with injections of living virus against fowl-pox that their serum shows marked viricidal properties. Their early method was to inject normal fowls intramuscularly with increasing doses of killed virus, in the form of ground-up, heated comb-scabs suspended in saline, followed by

several injections of living virus. Later, another method was used. Combs were scarified as in the production of fowl-pox vaccine and after the birds were unable to produce further comb-scabs, living virus was injected intramuscularly and after four or five increasing doses, a hyperimmune serum is produced. They are titrated either by scarification of separate areas of comb with mixtures of a test dose of virus and graduated dilutions of serum or by the intramuscular injection into separate birds of graduated amounts of serum, followed after 24 hours by intravenous injection of a test dose of virus.

Coccidiosis in Gallinaceous Birds. Ernest Edward Tyzzer. Amer. Jour. Hyg., x, (1929), 2, p. 269.

Although it is generally assumed that one species of coccidium (*Eimeria avium*) is widely distributed in many species of birds, the conclusion is reached in the present study that multiple species of Eimeria may be harbored by a single host species, as exemplified by the chicken. The author thinks it preferable to regard the different types of Eimeria found in the chicken as species rather than as subspecies or strains. Names have been suggested for new species. Morphological differences, the distribution of the parasite in the intestinal tract, the time required for development and for sporulation of oocysts, and the reaction of the host to the invading organism must be taken into consideration in the differentiation of the various species of Eimeria found in gallinaceous birds. Cross infection, employing certain of the species of Eimeria recognized to infect chicks, the pheasant, the turkey, and the quail, indicate in general a high degree of host restriction. A very thorough discussion of methods for maintaining coccidia-free stock, for collection and preservation of infective material, for the isolation of species, for the production and testing of immunity, and for the study of developmental cycles is given. The author lays stress on the advantages of utilizing natural protective principles rather than attempting to exclude coccidia completely from poultry.

The Effects of Feeding Rachitic Diets Containing Different Ratios of Calcium to Phosphorus on the Calcium and Inorganic Phosphorus of the Blood Serum of Chicks. O. N. Massengale. Poultry Sci., viii (1929), 6, p. 335.

When a rachitic diet, low in calcium but high in phosphorus, is fed to growing chicks, noticeable leg-weakness appears at an

earlier age than when a rachitic diet low in phosphorus but higher in calcium is fed. The blood serum of chicks on a rachitic diet, in which the calcium content is higher than the phosphorus, is higher in calcium than inorganic phosphorus. The reverse is true when the phosphorus content is higher than the calcium. When cod-liver oil is added to rachitic diets and fed to chicks suffering from leg-weakness, it tends to increase the calcium content of the blood serum, no matter what the ratio of calcium to phosphorus may be in the ration fed.

A Quantitative Study of Poultry Coccidiosis. Benjamin P. Young. Jour. Parasitol., xv (1929), 4, p. 241.

The prepatent period of avian coccidiosis, using Barred Rock chicks and segmented oocysts, is from four to five hours less than four days. Unsegmented oocysts, ingested a few hours after being voided by the host, may produce coccidiosis, while unsegmented oocysts ingested from twelve to eighteen hours after being shed are quite likely to produce the disease. If the chick is kept from reinfection the disease will run a rather limited course, but immunity to later infection does not seem to be developed by experimental inoculation. The appearance of fowl paralysis in one of the test birds infected a second time leads the author to support the assumption that fowl paralysis is one of the symptoms of chronic coccidiosis rather than in no way connected with coccidial infestation.

The Secretion of Uric Acid by the Fowl. O. S. Gibbs. Physiol. Absts., xiv (1929), 5, p. 302.

The bird's kidney can be perfused through the ureter. Fluids enter the kidney as high as Bowman's capsule. The pressure required is low. True selective absorption of such fluids was not demonstrated. After a short time the uric-acid-secreting mechanism becomes injured. It is inferred, therefore, that tubular absorption is not normal, though it can occur. The secretion pressure in the fowl's kidney is 10 to 20 cm. of water. It is considered that uric acid is actively secreted by the bird's kidney while water is probably filtered off by the glomeruli.

Manson's Eyeworm of Poultry. D. A. Sanders. Univ. of Fla. Agr. Exp. Sta. Bul. 206 (1929).

The author worked out the complete life history of Manson's eyeworm (*Oxyspirura mansonii*), finding a species of cockroach

(*Pycnoscelus surinamensis*) to be the intermediate host. After anesthetizing the eye, the nictitating membrane is lifted by means of forceps and one or two drops of a 5 per cent solution of creolin is placed directly on the nematodes. Irrigation with pure water should follow immediately.

Transmission Experiments with Fowl Paralysis. Alwin Pappenheimer et al. Jour. Exp. Med., xlix (1929), p. 87.

Inoculations of suspensions of brain, cord and ganglia or nerves of chickens with neurolymphomatosis lesions into newly hatched chicks are followed by the development of typical lesions in approximately 25 per cent of the cases. In control chickens, kept under laboratory conditions, the incidence of disease is about 7 per cent. The disease does not become manifest until at least two months after inoculation; symptoms may not appear until after four months. The active agent is not destroyed by 50 per cent glycerol in nine days at ice-box temperature.

Experimental Inoculation of Chickens with Hodgkin's Nodes. Elise E. L'Esperance. Jour. Immunol., xvi (1929), p. 37.

In chickens, a lesion with the histologic features of Hodgkin's granuloma and comparable to avian tuberculosis has been produced after the inoculation of emulsified Hodgkin's nodes. This may indicate that the etiologic agent in certain forms of Hodgkin's disease is pathogenic for birds or that the avian tubercle bacilli are a factor in producing some of the lesions which are interpreted as Hodgkin's disease.

Poisoning of Live Stock By Range Plants

To help veterinarians and owners of live stock to identify and then guard against the plants growing on the range which are poisonous to live stock, many of the plants are illustrated in their natural colors in U. S. Department of Agriculture Bulletin No. 1245-D, "Stock-poisoning Plants of the Range," which is a revision of a former bulletin on the same subject. Copies are available at 35 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C. The bulletin gives both the popular and scientific names of the poisonous plants, and also shows illustrations of animals suffering from plant poisoning. The author is Dr. C. D. Marsh, physiologist in charge of investigations of stock poisoning by plants, Bureau of Animal Industry, Department of Agriculture.

ARMY VETERINARY SERVICE

CHANGES RELATIVE TO VETERINARY OFFICERS

Regular Army

Captain Charles B. Dunphy, who has recently completed a tour of duty in the Panama Canal Department, has been directed to report for duty at Fort Sill, Okla. Orders directing Captain Dunphy to report for duty at Carlisle Barracks, Pa., have been revoked.

Colonel W. Geo. Turner has been relieved from additional duty as Attending Veterinarian, Veterinary General Dispensary, Washington, D. C.

Captain John H. Kintner is relieved from his present duty at Fort Sill, Okla., effective on or about October 15, 1929, and directed to report to the Commandant, Army Medical School, Washington, D. C., for temporary duty, and will then proceed to New York and sail on or about January 17, 1930, for the Philippine Department, for duty as a member of the U. S. Army Medical Department Research Board.

Veterinary Reserve Corps

New Acceptances

Cotton, Charles Edgcomb. Lt. Col... 3145 Portland Ave., Minneapolis, Minn.
Schaulis, Harry Edward...2nd Lt....919 Court St., Clay Center, Kans.

Promotions

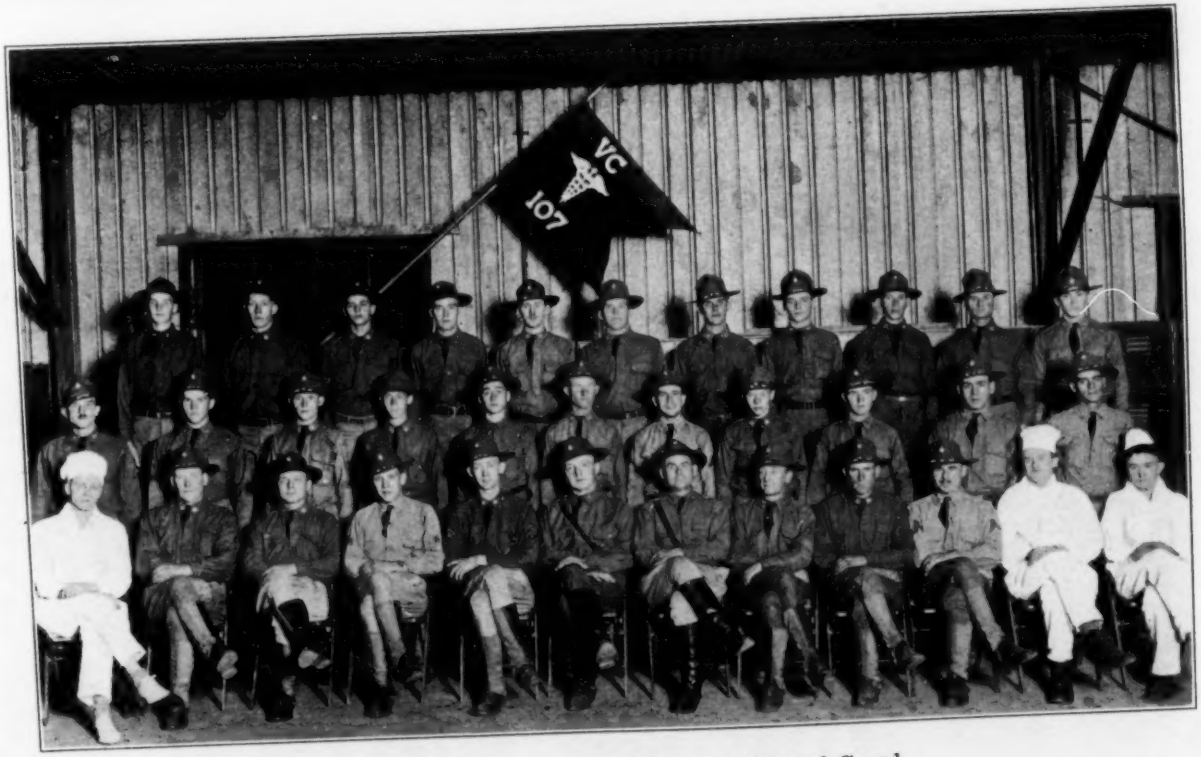
Tornow, Henry Wm.....to Major..1744 Park Place, Wichita, Kans.
Traylor, James T.....to Major..510 W. Filmore St., Harlingen, Texas.

107TH VETERINARY COMPANY, M. N. G.

The 107th Veterinary Company, a unit of the 107th Medical Regiment, 32nd Division, Michigan National Guard, won the Colonel Buck Trophy for efficiency in close-order drill, military discipline and company administration at Camp Grayling, Michigan, July 13-27, 1929. The Company has attended five annual encampments at Grayling and has never been defeated in the close-order drill competition, winning four times out of five. No competition was held in 1928.

The 107th Veterinary Company was one of the first to be recognized under the new table of organization for the Medical Regiment, gaining recognition September 24, 1924. The strength of this organization is now 36 enlisted personnel and two officers —Capt. Harry L. Cotton (O. S. U. '13), commanding, and Capt. Glenn Gordon (McK.'11), divisional meat inspector—seven non-commissioned officers and ten technicians.

The Veterinary Corps has proved very attractive to the enlisted personnel, drawing a very high quality of men and entailing



107th Veterinary Company, Michigan National Guard

a small turnover of enlistments. A large percentage of the men shown in the accompanying photograph were charter members of the Company, organized five years ago. The Company is fully equipped to care for the sick and wounded animals of the Division, being technically divided into a field collecting platoon and a field hospital platoon. In addition to providing veterinary surgical and medical aid for the animals of the Division, the Veterinary Company has charge of the mounts of the Medical Regiment.

Pan-African Veterinary Conference

At the Pan-African Agricultural and Veterinary Conferences held at Pretoria, in August, 1929, the following papers on veterinary subjects were presented, these having been subsequently issued as bulletins of the Department of Agriculture:

"Rinderpest Research in Kenya," J. Walker (Bul. 8a, 1929.)
"Prophylactic Vaccination Against Rinderpest," R. Daubney. (Bul. 8b, 1929.)
"Pleuro-Pneumonia Contagiosa Bovum," J. Walker. (Bul. 8c, 1929.)
"Memorandum of Horse Sickness Immunization," S. H. Whitworth. (Bul. 8d, 1929.)
"Contagious Pleuro-Pneumonia of Goats in East Africa," R. W. M. Mettam. (Bul. 8e, 1929.)
"Artificial Immunization and Immunity in Their Relation to the Control of East Coast Fever," J. Walker and S. H. Whitworth. (Bul. 8f, 1929.)
"Memorandum of Research on East African Swine Fever Immunization in Kenya," J. Walker. (Bul. 8g, 1929.)
"Veterinary Education with Particular Reference to State Services in the Tropics," R. Daubney and R. W. Mettam. (Bul. 8h, 1929.)
"Veterinary Education of Natives," A. G. Doherty. (Bul. 8j, 1929.)

Michigan Law Sustained

The Michigan Supreme Court, in an opinion rendered recently, upholds the conviction of Will Stimer, of Jackson County, Michigan, who refused to permit an authorized veterinarian to tuberculin-test his cattle, in December, 1927.

Four Circuit Court convictions have been secured under the act authorizing the compulsory tuberculin test of cattle in Michigan, but this represents the first opportunity for a review of the various contentions by the Supreme Court.

The decision of the Supreme Court was not unanimous but undoubtedly will be far-reaching in its effect, for it not only upholds the right of the State to tuberculin-test cattle, but also includes sanction of the act creating the State Department of Agriculture.

ASSOCIATION MEETINGS

PACIFIC NORTHWEST VETERINARY MEDICAL ASSOCIATION

The Pacific Northwest Veterinary Medical Association held its twelfth annual meeting at the Vancouver Hotel, Vancouver, B. C., July 15-16-17, 1929. From the moment President T. H. Jagger, of the British Columbia Association, called the meeting to order until the final adjournment, the program was filled with worth-while papers and interesting discussions. There were two addresses of welcome, one from His Honor, Mayor W. H. Malkin, and the other from Dr. Wallace Wilson, president of the British Columbia Medical Association.

Dr. E. A. Bruce, of Agassiz, B. C., opened the technical program with a paper on "Bovine Coccidiosis." He reported that this disease is not uncommon in the dry section during the winter months. The causal agent is *Eimeria canadensis*, not the same species that causes coccidiosis in Europe. This was followed by a paper by Dr. J. F. Rankin, of Astoria, Oregon, on "Surgery of the Teats and Udder." In this paper, Dr. Rankin discussed those surgical procedures which have proven successful in his practice.

A letter was read from Mr. O. M. Plummer, of Portland, Oregon, manager of the Pacific International Livestock Exposition, and a staunch supporter of the veterinary profession, in which Mr. Plummer extended best wishes and expressed regrets that he could not attend the meeting. Following the reading of this letter, Mr. Plummer was unanimously elected an honorary life member of the Association.

Dr. H. W. Hill, bacteriologist at the University of British Columbia, gave a very interesting paper on "What Effect, if Any, Has Lowered Resistance in Infectious Disease?" He deplored the rather loose use of the term "lowered resistance" and questioned whether there are reliable data proving environmental conditions influence resistance. Dr. R. E. Coleman, of Vancouver read the next paper, which was entitled, "Some Public Health Relations Common to Human and Veterinary Medical Practice." He urged the veterinarians to cooperate with the medical profession in reporting and controlling the diseases of humans which are animal-borne. These two contributions from the medical

profession were very much appreciated. Dr. J. W. Cook, of Wilbur, Oregon, a practitioner for forty-two years, was called upon next and gave his famous description of the classical operation of "quilling" cattle.

Dr. J. N. Shaw, of Corvallis, Oregon, gave a talk on "Liver Flukes," which was illustrated by a moving picture. This was followed by two papers with moving pictures by Dr. J. E. Schillinger, of the Bureau of Biological Survey, U. S. Dept. Agriculture, Washington, D. C. The first was "Diseases and Parasites of Foxes" and the second, on "Handling Foxes." These two papers were of special value because of the extensive development of the fox industry in the Pacific Northwest.

The next paper on "Meat Inspection Requirements in the State of Washington," by Dr. Robert Prior, was very well received. Following this the meeting adjourned for the first day.

With Dr. J. F. Rankin, president of the Oregon Veterinary Medical Association, in the chair, the second day's program opened with a talk entitled "Case Notes," by Dr. R. G. Cuthbert, of Vancouver, B. C. He reported two cases of rupture of the tendon of Achilles.* Dr Clifford Ackley, of Winlock, Washington, read the next paper entitled "Bovine Sterility." This was followed by a paper by Dr. E. R. Derflinger on "The Control of an Outbreak of Anthrax in 1928." All three of these papers were discussed very freely. This concluded the morning session.

Dr. J. G. Jervis, of Milner, B. C., gave the first paper of the afternoon on "Infectious Mastitis." He reported experimental studies which he had conducted. The next paper, "Case Reports" was by Dr. F. C. Myers, of Corvallis, Oregon. Dr. J. E. Schillinger read the last paper of the afternoon, on "The Veterinarian and the Silver Fox Industry." All these papers were of so much interest that the Chair was forced to limit discussion.

On the evening of July 16, a few more than a hundred people attended the banquet. Dr. S. F. Tolmie, Prime Minister of British Columbia, and a well-known veterinarian of the Pacific Northwest, acted as toastmaster. Following the banquet the floor was cleared and a dance was enjoyed.

On the morning of July 17, Dr. G. W. Staggs, vice-president of the Washington Veterinary Medical Association, occupied the chair. He called on Dr. J. M. Hanrahan, of Woodburn, Oregon, for the first paper, "Six Months of Sheep and Goat Practice by a Novice." He reported apparent results from the

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use of beechwood creosote as a treatment for lung worms. The next paper, "Infectious Bronchitis in Fowls," was by Drs. C. E. Sawyer and C. M. Hamilton, of Puyallup, Wash. This was followed by a classical discussion by Dr. R. S. Foster, of Portland, Ore., on "The Dog's Eye; Its Anatomy and Diseases, and the Use of the Ophthalmoscope." This proved to be one of the best papers ever presented at a meeting in the Pacific Northwest.

At the business meeting the following officers were elected by the Washington State Veterinary Medical Association: President, Dr. G. W. Staggs, Chehalis; and secretary-treasurer, Dr. Clifford Ackley, Winlock. The Oregon Veterinary Medical Association elected the following: President, Dr. J. F. Rankin, Astoria; and secretary-treasurer, Dr. B. T. Simms, Corvallis.

Chehalis, Wash., was selected for the place of meeting for 1930. After adopting the report of the Resolutions Committee, the meeting adjourned.

MARYLAND STATE VETERINARY MEDICAL ASSOCIATION

The semiannual meeting of the Maryland State Veterinary Medical Association was held at the University of Maryland, College Park, July 18-19, 1929, with about seventy-five in attendance.

The meeting was called to order by the President, Dr. John P. Turner, of Washington, D. C. The presidential address was a résumé of the important developments in the veterinary field which have occurred during the past few months. It is pleasing to note that there seems to be a more or less general prosperity of the profession in Maryland. The tuberculosis eradication work is moving along very nicely and several counties are practically ready for accreditation. Dr. E. B. Simonds and his staff are to be congratulated for their splendid work.

Contagious abortion continues to be the most serious disease affecting our cattle. An accredited-herd plan has been worked out for the purpose of combating the disease. This plan was endorsed by our Association at the last meeting and has been approved by the State Board of Agriculture. It is hoped that it will be put in the field at the earliest available opportunity. Blackleg and forage poisoning were encountered on numerous farms during the year. The methods employed in hog cholera control are attracting attention in other states, as Doctor Ather-

ton recently appeared on the program at the Eastern States Tuberculosis Conference, and at the meeting of the Virginia State Veterinary Medical Association.

In the dairy field, the District of Columbia stands alone as employing veterinary inspectors exclusively. It is very much hoped that these inspectors will realize the importance of their trust and will make every possible effort to conduct the work most efficiently, as many states are looking to Washington, D. C., to lead the way. The certified herd owners are eradicating contagious abortion as rapidly as possible, and it is hoped that most of them will be free of the disease within a year. The large milk companies now have plants from coast to coast. Are they responsible for the enormous pressure which is apparently being placed on the U. S. Public Health Service to compel the adoption of the uniform milk regulations?

Other developments during the year are the finding of the cause of trench mouth in dogs by Dr. H. F. Dailey, of Boston; the development of dog distemper vaccine, the finding of the Bang organism in fistulous withers and poll-evil, and in poultry.

The second paper was entitled, "Diseases of the Feet of Cattle," and was delivered by Dr. H. E. Bemis, Professor of Veterinary Surgery, University of Pennsylvania. It covered a discussion of the differences in the anatomy of the foot of the horse and ox, followed by a description of the more common surgical diseases of the foot and their operative treatment, including two methods of amputating the claw in case of penetration of suppurative processes into the joints. The paper was most instructive, and it was gratifying to learn that it will probably be published in bulletin form.

The third paper was on "Sheep Diseases," and was presented by Dr. Henry W. Turner, Pennsylvania Bureau of Animal Industry, Harrisburg. Among other things, Doctor Turner called attention to the fact that sheep, to be profitable, must receive proper food and good care. He told how to handle and drench sheep; also going into detail as to the management of the flock at lambing time.

Under diseases, he described the method of examining sheep, calling attention to the fact that sheep are ruminants and subject to the same character of diseases as other ruminants. He described many of the common diseases met with, and also stated that it is estimated that about seventy per cent of all diseases in sheep are due to parasites, impressing on the veterinarians that

they should take more interest in sheep and their diseases. Doctor Turner's paper was very much appreciated.

The last paper of the first morning consisted of some most interesting case reports on "Swine Diseases," and was delivered by Dr. T. A. Ladson, practitioner, Olney, Maryland. One experience was about as follows: A client advised that of his herd of sixty hogs, ten were sick and two were dead. He had the two examined and the diagnosis was hemorrhagic septicemia. As hog cholera is frequently associated with hemorrhagic septicemia, he recommended that the anti-hog cholera serum be used. Another pig died before the serum arrived the next morning, and postmortem findings revealed progressive lesions of hog cholera. The lungs were also much involved.

Pigs that were very sick were injected intra-abdominally and the others subcutaneously. The remaining hogs all lived, and a ton litter from this herd won second place at a local fair that fall.

The following spring the owner again advised that his pigs were acting as they did the year before. A postmortem on two revealed only a heavy worm infestation. These two carcasses and a sick pig were submitted to a laboratory for examination and the report was a suggestion to treat for worms. This was done and they improved for about a month, then several got sick. One finally died and lesions of hog cholera were found. This time both anti-hemorrhagic septicemia serum and anti-hog cholera serum were used, and all the remaining animals again recovered.

The afternoon was devoted to clinics. Dr. H. E. Bemis took charge of the large-animal work and demonstrated several operations. Dr. I. M. Cashell conducted the work on small animals. Dr. Henry Turner demonstrated methods used in the handling of sheep and passing the stomach-tube. Captain E. L. Nye, of the Surgeon General's Office, demonstrated the Army method of passing the stomach-tube in the horse.

The banquet was held in the evening, at the University Dining Hall. Dr. J. P. Turner, president of the Association, acted as toastmaster. The prominent speakers were Dr. R. A. Pearson, president of the University of Maryland; Miss Ruth Tyrrell, humorist and philosopher, Washington, D. C.; Dr. A. F. Woods, Director of Research, U. S. Department of Agriculture; Dr. J. C. Collingson, State Board of Health; Dr. W. R. Crawford, Westminster, Maryland; Mr. I. W. Heaps, Secretary, Maryland

State Dairymen's Association; and Dr. Hulbert Young, Walker-Gordon Laboratories, Baltimore, Maryland.

The first paper on the morning of the 19th was delivered by Dr. W. S. Gochenour, Bureau of Animal Industry, U. S. Department of Agriculture. It was entitled, "Blackleg—Its Nature, Cause and Prevention." It consisted of a discussion of the disease as it affects cattle and sheep. The typical blackleg infection in cattle was described, and reference was made to the less commonly observed manifestation of the disease.

In the diagnosis of blackleg attention was called to the closely related anaerobic infections that may be encountered. A description of the laboratory methods was given, together with suggestions concerning the collection and shipment of specimens to the laboratory. Concerning the immunization against blackleg disease, references were made to the different kinds of vaccine available to the veterinarian.

The second paper was entitled, "A Simplified Agglutination Test for Pullorum Disease." It was read by Dr. Hubert Bunyea, Bureau of Animal Industry, Washington, D. C. Drs. M. Dorset and W. J. Hall were co-authors.*

The third paper of the morning was delivered by Dr. W. E. Cotton, Director of the Experiment Station, Bethesda, Maryland. It was entitled, "Combating Infectious Abortion." Dr. Cotton stated in part as follows:

> Infectious abortion may well be classed as one of the worst, if not the worst of our animal plagues, and is now attracting much interest; first, because it causes greater financial loss than any other disease; second, because there is great hope of controling it; and third, because it has been proved to have a significance for human health, but which is as yet unmeasured. The Bureau of Animal Industry has estimated that the annual loss from the disease exceeds $50,000,000.00.

After a most interesting account of certain phases of the disease and methods employed in combating it, Dr. Cotton went on to say:

> The work of investigating the disease is actually going on, increased appropriations have made it possible for the Bureau to take up cooperative research with eight state universities or experiment stations. Projects covering a number of problems, not only in connection with the nature and control of Bang's infectious abortion, but of abortion caused by other factors as well, have been undertaken. It is my belief that reasons for the seeming differences obtained by different investigators are going to be found as research adds to our knowledge, and that the time is not far off when we will be certain as to what procedure is best to use in handling any given herd.
>
> The practicing veterinarian has a very important function in the fight against abortion. He should keep pace with the newer facts as they are discovered and make use of them in his practice. He can greatly aid the

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investigator by reporting his successes or failures and observations. With the cooperation of the practitioner, the stock-owner and the investigator, I am confident that the fight against infectious abortion will within a reasonable time be won.

The last paper of the morning session was entitled "Veterinary Medicine and the A. V. M. A.," and was delivered by Dr. T. E. Munce, president of the American Veterinary Medical Association. The author brought greetings from the A. V. M. A. and the Pennsylvania Association. He sketched the history of the A. V. M. A., pointing out a number of its major activities and accomplishments. He also suggested that our State Association appoint a committee to confer with similar ones from other states, as well as one from the A. V. M. A., on the advisability of establishing closer relations between the state associations and the A. V. M. A. Doctor Munce also stressed the importance, both to the associations and to the individual members, of having all veterinarians belong to their state and national organizations. As a result of this paper, several applications were turned in.

The second afternoon was devoted to clinics. Dr. H. E. Bemis again took charge of the work. He demonstrated several foot operations on cattle. Dr. W. J. Hall, B. A. I. Experiment Station, Bethesda, Md., demonstrated the simplified agglutination test for pullorum disease, as outlined in the paper given at the morning session by Dr. Bunyea.

E. M. PICKENS, *Secretary-Treasurer.*

VIRGINIA STATE VETERINARY MEDICAL ASSOCIATION

The thirty-seventh annual meeting of the Virginia State Veterinary Medical Association was held at Winchester, Virginia, July 25-26, 1929. Fifty veterinarians and twenty-six of their wives were present. The President, in his annual address, urged the ladies to organize an auxiliary, which, by the way, was done.

Dr. L. E. Starr, of Blacksburg, read a paper on "Blackhead in Turkeys." Dr. J. P. Turner, of Washington, and Dr. J. M. Buck, of the U. S. Bureau of Animal Industry, discussed the abortion question from every angle. These two papers were of outstanding importance and were very interesting. Dr. W. H. Grubb, of Purcellville, read a paper on "Professional Ethics."

After luncheon we adjourned to the fair grounds to attend a small-animal clinic. Dr. L. E. Starr demonstrated several diseases of poultry and methods of holding postmortem exam-

inations. Dr. P. F. Galloway, of Richmond, performed several operations on dogs, and Dr. G. C. Faville demonstrated a method of diagnosing *Filaria immitis* by use of the microscope and postmortem.

The banquet at 7:30 was a very enjoyable affair. Sixty-three covers were laid, and the members and ladies gave themselves up to a real get-acquainted time. Among the toasts, Capt. F. C. Sager, of the Remount Station, at Front Royal, told of some of the Army veterinarians' troubles; Dr. Adolph Eichhorn described the proposed trip through Europe next summer; Dr. J. M. Buck spoke of the importance of research work; Mrs. Faville spoke for the ladies; Dr. Faville told something of his motor trip through the West; Dr. E. E. McCoy told of his experiences (some of them) as a U. S. inspector, and Dr. I. K. Atherton told some stories and jokes.

At the Friday morning business session, after the election of several new members, the subject of a graduate veterinary conference at Blacksburg during the winter was taken up, and it was agreed that the school be asked to put on such a conference. On motion, the same officers were elected to retain their offices for another year.

Dr. I. K. Atherton, of College Park, Md., read a paper explaining the Maryland method of hog cholera control. This brought on a very interesting discussion. Dr. Adolph Eichhorn discussed in his usual interesting manner his visit to England and the Laidlaw-Dunkin distemper vaccine. Dr. E. E. McCoy read a paper on sheep scab which was interesting and, above all, practical.

After luncheon we attended a large-animal clinic directed by Dr. H. E. Bemis of the University of Pennsylvania. This was the high spot of the meeting.

This was one of the most interesting and best attended meetings of this Association.

GEO. C. FAVILLE, *Secretary.*

CONFERENCE OF GRADUATE VETERINARIANS OF ONTARIO

During the week of July 29 to August 3, 1929, a conference for graduate veterinarians was held at Guelph, Ontario, by the Ontario Veterinary College. The program was entirely of an educative and instructive character and as far as possible each day's activities were confined to one particular phase of veterinary

science. Each day's studies were thrown open for discussion at an evening session in which the members present had the privilege of asking questions and placing before the meeting their own views regarding the subject. The course was remarkably well attended, there being an average of forty present each day. Geographically the Province was well represented, for members of the profession were in attendance both from the eastern and western extremities and from the north and south.

The first day's instruction was given on the subject of poultry diseases, covering in a general way the most important diseases of fowl, with demonstrations of tuberculin testing, agglutination testing, diagnostic and postmortem technic. On the second day a symposium of abortion disease was held, followed by a lecture on breeding diseases, sterility and impotency. In the afternoon practical demonstrations were held on gravid and non-gravid uteri, on obtaining blood samples for agglutination, and sterility cases were examined and diagnosed with discussion as to the proper methods of handling and treatment.

On the third day the first item was a symposium on blackleg, in which the latest preparations used for vaccination were carefully explained and discussed. The remainder of the day was devoted to parasitic diseases of sheep, swine, foxes and dogs. Clinical cases in each of these species of animals were placed before the classes for examination and observation. Demonstrations of the administration of anthelmintics and parasiticides in these animals were also shown. Following, the animals were destroyed and postmortem examinations made revealing parasitic infestations and the lesions they produce. Further instruction was imparted by demonstrating the diagnosis of parasites through a microscopic examination of fecal material to determine the presence of parasitic ova.

The items under discussion on the fourth day consisted of a symposium on hemorrhagic septicemia, a lecture on nutritional diseases and, in the afternoon, discussions and demonstrations on udder and teat troubles, sterility diagnosis and operative procedure in cryptorchidism of pigs and ovariectomy in bitches. On the last day congenital diseases of the new-born, white scours and calf pneumonia were discussed. This was followed by a discourse on dairy hygiene and a practical demonstration of milk and stable inspection work.

On the evening of the first day the members of the course organized, appointing Dr. C. M. Higginson, president of the

Central Canada Veterinary Association, as their chairman and Dr. H. M. LeGard, secretary of the Ontario Veterinary Association, as their secretary, who recorded the attendance and other data regarding the course. By way of appreciation a banquet was tendered to the faculty of the College on Thursday evening, which was held in the students' room and at which a number of the graduates expressed their gratitude to those responsible for the organization of the course and also stated that they believed this event was one of the most important in the annals of the profession in Ontario. The course of instruction was under the direction of the following members of the college faculty: Drs. C. D. McGilvray, Principal, R. A. McIntosh, R. Gwatkin, H. E. Batt, L. Stevenson and J. S. Glover.

R. A. McI.

HUDSON VALLEY VETERINARY MEDICAL SOCIETY

The regular quarterly meeting of the Hudson Valley Veterinary Medical Society was held at Kenozia Lake, N. Y., August 7, 1929. Number present, 26. The speaker of the day was Dr. Adolph Eichhorn, of Pearl River, who gave a very complete discussion of canine distemper and its treatment by the Laidlaw-Dunkin method. Dr. Eichhorn explained the method of preparing the vaccine and the advantages and disadvantages of its use. The discoveries made by the English Commission in the study of dog distemper were referred to as valuable in connection with the study of other diseases (both man and animal), the speaker referring to certain principles that could be applied in the study of other serious diseases which had defied research workers up to the present time.

In answer to questions, Dr. Eichhorn explained the technic of administering distemper vaccine and the conditions under which it should be given. He stressed the importance of having the patient in good condition before administering treatment. Following Dr. Eichhorn's address, general case reports were given, a discussion on the treatment of snake bites being a feature. After a unanimous vote of thanks being extended to Dr. Eichhorn for his address, the meeting adjourned.

J. G. Wills, *Secretary.*

SAGINAW VALLEY VETERINARY MEDICAL ASSOCIATION

A very successful meeting of the Saginaw Valley Veterinary Medical Association was held in Chesaning, Mich., September 30, 1929.

The meeting opened at the plant of the Peet Packing Co. Dr. B. J. Killham, assisted by Dr. F. L. Burlingame, inspector at the plant, demonstrated the technic of meat inspection on hogs, while Drs. E. T. Hallman and C. L. Clark handled the inspection of cattle. A very enjoyable and instructive forenoon was spent at this place.

After the forenoon session, lunch was served to the veterinarians who were in attendance, by the ladies of the Episcopal Church, in the dining-room of the Odd Fellows Hall. After lunch Dr. Killham gave a short talk on the success of the A. V. M. A. meeting held in Detroit this year. Dr. Burlingame was given a rising vote of thanks for his efforts in making the meeting a success.

After lunch the time was spent on clinical work at the Naessens sale barn, where Dr. E. K. Sales, assisted by Drs. Clark and Cole, operated upon one case of fistulous withers, one case of poll-evil and amputated the penis of a stallion. Dr. A. E. George, of Flint, had charge of the small-animal clinic, and was assisted by Drs. Cole and Coomer. Two bitches were spayed and other work was done.

Dr. E. T. Hallman, assisted by Drs. Cole and Clark, conducted the sterility clinic, and demonstrated the benefits of using a speculum and artificial light in examining the vagina and cervix for abnormal conditions. Dr. J. S. Donald, of Bay City, amputated the clitoris of a vicious mare. Dr. Burlingame demonstrated the use of intravenous medication in treating a case of periodic ophthalmia in a horse, and castrated a ridgling (monorchid).

There were between forty and fifty veterinarians in attendance at the meeting, and all declared it a success.

M. D. Ducey, *Secretary.*

Many Specimens Examined

The Department of Veterinary Science of the Wisconsin College of Agriculture received 21,125 specimens for laboratory diagnosis the past year. Of these the largest portion (17,003) consisted of blood samples to be tested for contagious abortion. Poultry diseases furnished the next largest number, with 3,502 specimens, indicating the importance of this particular field, as well as the desire, upon the part of veterinarians and poultry-owners, to know more about the diseases of the feathered tribe.

NECROLOGY

R. R. DINWIDDIE

Dr. R. R. Dinwiddie passed away at his home in Rogers, Arkansas, August 3, 1929, at the age of 60 years.

Born in Scotland, Dr. Dinwiddie attended Edinburgh University and studied under the great Lister. He was a graduate of the Ontario Veterinary College (1886) and held a degree granted by the Johns Hopkins Medical College.

Dr. Dinwiddie joined the A. V. M. A. in 1893. At that time he was located at Fayetteville, Arkansas, as veterinarian to the Arkansas Agricultural Experiment Station. He later held the position of pathologist and bacteriologist to the Station. He made important contributions to the study of anthrax, hog cholera and Texas fever. About fifteen years ago, Dr. Dinwiddie retired from active work, due in part to a failing eyesight which greatly handicapped him in his laboratory work.

The deceased was a man of exceedingly retiring disposition and inherent modesty, but was courageous in the defense of his work. He engaged in a number of spirited discussions with some of the world's outstanding scientists. Those of the present decade who did not have an acquaintance with Dr. Dinwiddie missed much in not having had the privilege of following him in his wonderful work. He bequeathed his scientific library to the Arkansas Medical College, University of Arkansas. He is survived by his widow, one son and one daughter.

J. H. B.

JOSEPH A. BRILL

Dr. Joseph A. Brill, of Dow City, Iowa, died in an Omaha hospital, September 2, 1929, at the age of 39. Dr. Brill was graduated from the Victor (Colo.) High School in 1908 and from the Colorado Agricultural College in 1912. For several years, Dr. Brill was located in Kansas City in serum-virus control work. In 1916 he entered general practice at Dow City, Iowa, and was highly successful as a general practitioner.

Dr. Brill joined the A. V. M. A. in 1916. He was a member of the Zeta Chapter of Alpha Psi Fraternity. He was a member of the Iowa Veterinary Medical Association. He is survived by his widow, one daughter and one son.

JOSEPH E. NANCE

Dr. Joseph Ervin Nance, of Oklahoma City, Okla., died suddenly at the University Hospital, September 26, 1929. Heart disease was the cause of death.

Born at Tuscola, Ill., August 6, 1877, he moved with his parents to Salisbury, Mo., while still a boy. He attended the Salisbury Academy and later the Kansas City Veterinary College. He graduated with the class of 1907 and entered the service of the U. S. Bureau of Animal Industry. Dr. Nance was assigned to meat inspection at Chicago.

From 1908 to 1911, Dr. Nance served as veterinarian to the Philippine government. From 1911 to 1917, he was in general practice at Anadarko, Okla. In 1917 he accepted a position as instructor at the Oklahoma A. & M. College, Stillwater. He held this position for one year. In 1918 he located in Oklahoma City, where he engaged in private practice and live stock raising. He specialized in milk goats.

Dr. Nance joined the A. V. M. A. in 1910 and served as resident secretary for Oklahoma 1916-1917. He was a member of the Oklahoma State Veterinary Medical Association and served the organization as president in 1922. Dr. Nance is survived by his widow and three children.

HOWARD LEWIS WILLIAMS

Dr. Howard L. Williams died at his home near Granville, Ohio, October 8, 1929, of cerebral hemorrhage. He was born May 4, 1872, in the same house in which he passed away. Dr. Williams was a graduate of the Ontario Veterinary College, class of 1903. The year after graduation he located at Newark, Ohio, where he conducted a general practice until 1913, when he returned to Granville.

When the United States entered the World War, Dr. Williams was the first man in his community to enlist. He enlisted in August, 1917, and was stationed at the Remount Depot, Fort Reno, Oklahoma, until his discharge in July, 1919.

Dr. Williams is survived by his widow, one brother, one sister, one daughter and one son. Military funeral services were conducted from the home.

FREDERICK M. ASHBAUGH

Dr. Frederick M. Ashbaugh died at the War Department Convalescent Home, Washington, D. C., April 7, 1929, after an illness of several months.

Born in Hamilton, Ontario, Canada, January 26, 1874, Dr. Ashbaugh received his primary education in the public schools and afterwards attended the Collegiate Institute, in Winnipeg, Man., in which city he resided for fourteen years. Coming to the United States in 1896, he first lived in St. Paul, Minn., for five years, and then removed to Washington, D. C. Soon after his arrival in the latter city, he entered the United States College of Veterinary Surgeons and was graduated with the class of 1904. In January, 1901, Dr. Ashbaugh was appointed clerk in the Adjutant General's Office. At the time of his final illness, he was in direct charge of the appointment, assignment and management of the entire subclerical force of the Adjutant General's Office. In 1905, Dr. Ashbaugh was appointed professor of meat and milk inspection and sanitary medicine at the United States College of Veterinary Surgeons, a post which he held until 1927.

Dr. Ashbaugh joined the A. V. M. A. in 1915. He was a member of the Elks and of the Masons.

PERSONALS

Dr. O. A. Buddenbaum (Chi. '17) has returned to Metropolis, Ill.

Dr. A. F. Hanna (San Fran. '12) has removed from Fortuna to Ferndale, Calif.

Dr. James C. Nowlen (Chi. '18) has removed from Woodstock, Ill., to Sycamore, Ill.

Dr. Paul S. Dodd (Ind. '18), of Charleston, Ill., has been re-engaged as Cole County Veterinarian.

Dr. Alexander Gow, Jr. (Corn. '29) has accepted a position at the University of Maryland, College Park, Md.

Dr. H. J. Buehler (Mich. '29), of Sparta, Mich., is now located in Indianapolis, Ind., at 1430 N. Capitol Ave.

Dr. J. P. Delaplane (O. S. U. '29), of Greenville, Ohio, has located at Eaton, Ohio, where he will engage in general practice.

Dr. L. A. Dibert (Chi. '11), of Cullom, Ill., is constructing a combination office and garage at the rear of his residence.

Dr. D. W. Mack (Ont. '86) has resigned as Chief Milk Inspector of Portland, Ore., after 21 years of service in that position.

Dr. Chester Clark (M. S. C. '29) is taking graduate work at Michigan State College toward the degree of Master of Science.

Dr. J. W. Oltmanns (Chi. '16) has resumed general practice at Watseka, Ill., after spending a year in tuberculosis eradication work.

Dr. W. B. Redman (Iowa '22), of Boxholm, Iowa, has purchased the practice of the late Dr. J. A. Brill (Colo. '12), at Dow City, Iowa.

Dr. E. B. Osborn (McK.'13) is pursuing investigations in mastitis in the Veterinary Department, University of Wisconsin, Madison.

Dr. J. P. Clark (K. C. V. C. '18), formerly of Pleasant Hill, Mo., is now located at Stronghurst, Ill., and engaged in general practice there.

Dr. Dwight S. Church (Ont. '95), of the Pennsylvania Bureau of Animal Industry, has been transferred from Erie, Pa., to Clarks Summit, Pa.

Dr. T. P. Bett (Ont. '29) is located at 12041 E. Jefferson Ave., Detroit, Mich., where he is associated with the Detroit Canine Hospitals, Inc.

Dr. James T. Glennon (N. Y. C. V. S. '96), of Newark, N. J., has a son enrolled as a freshman at the University of Pennsylvania Veterinary School.

Dr. Arthur W. Smith (N. Y. C. V. S. '98), of West Orange, N. J., is a candidate for the General Assembly from Essex County on the Republican ticket.

Dr. Raymond H. Aull (Iowa '15), of Dayton, Ohio, recently took out a building permit for the erection of a new veterinary hospital at an estimated cost of $11,500.

Dr. George E. Jacobi (O. S. U. '20) has resigned his position with the Jensen-Salsbery Laboratories, Kansas City, after spending five years with that well-known firm.

Dr. L. D. Bashore (Cin. '15), of Paulding, Ohio, whose illness was reported in a recent issue of the JOURNAL, has sufficiently recovered to be able to resume his practice.

Dr. C. L. Sanders (Cin. '16) has a new location at 705 South Main St., Dayton, Ohio. This is right in between the main residential and business sections of the City.

Dr. T. S. Leith (Iowa '14), of Oskaloosa, Iowa, has accepted a position in the Anatomy Department, Division of Veterinary Medicine, Iowa State College, Ames, Iowa.

Dr. Frank Hare (K. S. A. C. '20) has resigned his position as pathologist and consulting veterinarian for the Delaware State Board of Agriculture and has located in Lexington, Ky.

Dr. M. E. McDonald (K. S. A. C. '12) has succeeded Dr. C. U. Duckworth as Chief of the Division of Dairy Control, California Department of Agriculture. Dr. McDonald formerly was assistant chief.

Dr. John G. Hardenbergh (U. P. '16), of the Walker-Gordon Laboratories, Plainsboro, N. J., attended the recent meeting of the International Association of Dairy and Food Inspectors in Memphis, Tenn.

Dr. M. C. Hawn (Iowa '27) has resigned his position in the Veterinary Laboratory, at the University of Wisconsin, to accept a position on the staff of the North Shore Veterinary Hospital of Dr. J. V. Lacroix (K. C. V. C. '06), at Evanston, Ill.

Dr. Solon N. Blackberg (Corn. '18) who has been at Tulane University, New Orleans, for several years, is now a member of the staff of the Department of Pharmacology, College of Physicians and Surgeons, Columbia University, New York City.

Dr. C. E. Edmunds (Ont. '06-Amer. V. C. '08), formerly of Ardsley, N. Y., is Supervising Inspector of Dressed Poultry, Bureau of Agricultural Economics, U. S. Department of Agriculture, with headquarters at 507 Mercantile Exchange Bldg., Chicago, Ill.

Dr. R. K. O'Neil (Corn. '27) and Dr. P. H. Sager (Chi. '16) have opened the Grosse Pointe Small Animal Hospital at 15211 Kercheval Ave., Grosse Pointe Park, Mich. Drs. O'Neil and Sager were formerly associated with the Detroit Canine Hospitals, Inc.

Dr. M. E. Gouge (K. C. V. C. '10), of Sedalia, Mo., has been appointed District Deputy Grand Exalted Ruler of the Elks for the West District of Missouri for the year 1929-1930. Dr. Gouge is a Past Exalted Ruler of the Sedalia Lodge of Elks.

Dr. C. A. Sotaaen (McK. '09), of Windom, Minn., scored 362 points to gain first place in the first round of a horseshoe-pitching tournament held by a St. Paul newspaper the latter part of September. Dr. Sotaaen competed against sixty-six contestants.

Dr. G. S. Harshfield (O. S. U. '26), of Warren, Ohio, has resigned his position as veterinary inspector with the Ohio Division of Animal Industry to take post-graduate work at Ohio State University and assist in the Department of Pathology, College of Veterinary Medicine.

Dr. Aubrey M. Lee (K. S. A. C. '22), who has been Assistant Veterinarian at the Wyoming Agricultural Experiment Station, Laramie, for several years, is now at the College of Veterinary Medicine, Ohio State University, Columbus, as assistant in the Department of Pathology.

Dr. C. U. Duckworth (Ind. '21) resigned his position as Chief of the Division of Dairy Control, California Department of Agriculture, several months ago, to accept the position of Technical Director, with the Adohr Creamery Company and Adohr Stock Farms, of Los Angeles.

Dr. D. L. Allen (A. P. I. '17), who has been with the State Live Stock Sanitary Board of Mississippi, at Newton, Miss., has resigned to accept a position with the Department of Health, Chambers County, Ala., as meat and milk inspector, succeeding Dr. J. M. Luke (A. P. I. '12), with headquarters at Lanett, Ala.

Dr. Roberto Plata Guerrero (U. P. '20) has severed his connection with the Department of Agriculture of Eucador and has gone to Bogota, Colombia, where he is engaged in private practice. When leaving Quito, the Government of Ecuador honored Dr. Guerrero with a beautiful certificate on sheepskin and a gold veterinary insignia designed by a prominent painter. These were given to Dr. Guerrero as a token of appreciation for his services rendered the Government of Ecuador.

Dr. I. F. Huddleson (Mich. '25), of Michigan State College, who has spent the past five months in Europe and Africa studying Brucella infections in the human, cattle, goats and sheep, has returned and reports as enjoyable and profitable trip. Dr. Huddleson was in the service of the United States Public Health Service and spent much of his time in Tunis, Algeria and Maltese Islands, visiting also in Italy, Austria, France, Belgium and England. Since being back in this country, he says he misses beer at 2½ cents a glass and wine at 15 cents a quart.